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The Electricity (Supply) Act, 1926.

OVER 19 months ago (on May 20th, 1925) the Weir Committee submitted its report on electricity supply development to the Minister of Transport, and we were then assured that as soon as the Government had considered it, legislation would be quickly produced. The Prime Minister intended, we remember, that a Bill should be passed before Christmas, 1925, but no Bill was forthcoming until March, 1926. Had the Government taken advantage of the interval to consult the leaders of the electricity supply industry and obtain their expert advice on the subject, not only should we have had a better Bill, but also its path through Parliament would have been smoother and its passage quicker.

However, a policy of secrecy was adopted by the Cabinet; the Weir Committee's report was rigidly withheld from public comment, and presumably its contents were accepted by the Government at their face value in the absence of informed criticism. The Bill was moulded in strict secrecy, and after a prologue by Mr. Stanley Baldwin was sprung upon the world amid a chorus of applause from the political Press, which understood little more than the promises of "cheap electricity" with which it was accompanied, but was well fed with eulogistic "copy" by those interested.

Even then much might have been done to modify and improve the scheme embodied in the Bill, if prompt action had been taken by the industry; but apart from belated resolutions passed by the Council of the Institution of Electrical Engineers and by the Incorporated Municipal Electrical Association, and the individual efforts of leading members of the industry, no serious attempt was made outside Parliament to save the situation, and the efforts of the gallant band of "die-hards" in Standing Committee "C" only earned for them the accusation of obstruction. The Bill was thoroughly unpopular with every section of the electricity supply industry, and indeed it was hard to find support for it in any branch of the electrical industries; we believe the Government has realised this fact, and its own adherents have not concealed their dislike for the measure.

However, the Bill has now become an Act of Parliament. As such it commands our respect and support; as Lord Derby pointed out at the Beama dinner, it is our duty to do our utmost to make it a success and

to facilitate its operation. We hope that this view will be adopted by all our readers, and that throughout the electrical profession and industry the provisions of the Act will be loyally observed, in a spirit of co-operation for the national welfare.

We look forward with keen interest to the announcement of the names of the members of the Central Electricity Board, to whom, with the Electricity Commissioners, will be entrusted the development of electricity supply in this country. Rumour has already been busy in this field, but no tangible fact has emerged. We are promised the names early in the New Year.

The Spirit of Christmas.

THOUGH we have devoted a good deal of space during the last few weeks to the description of appropriate electrical gifts for Christmas and the New Year, there remains one important thing to say. When we are thinking of everybody else, let us not forget the troubled and distressed who ought to receive comfort and cheer, not necessarily merely at Christmas time, but in cases throughout the whole year, from one or other of the two Benevolent Funds which exist in connection with the electrical profession and industry. We know no better way of bringing this matter right home to the heart than that adopted by Mr. W. Y. Anderson, the honorary treasurer of the Institution of Electrical Engineers, South-Midland Section, in an appeal issued this month on behalf of the I.E.E. Benevolent Fund. Some of us knowing of hard cases which have brought into the throat a lump which would not be choked down have felt for years that if only we could disclose the full details there would be a direct and irresistible pull on many pockets. But confidence and secrecy must be preserved. Mr. Anderson, without any breach in this respect, gives two typical cases which he has recently had to investigate, with the result that the extreme hardship which otherwise seemed inevitable was prevented by assistance from his fund. Let us quote the circumstances:—(1) An A.M.I.E.E. in ill-health, out of a situation, with a very delicate wife and two children, was granted in all £60 spread over three payments of £20 each; (2) a widow with three young children, depending entirely upon a small sum from her parents-in-law, being otherwise destitute, was helped by a grant of £1 per week. It is Christmas Eve, reader! However prosperous the electrical industry, there will always be some in the great family circle whose story is one of silent tragedy. Can we contemplate such cases of want, anxiety, and suffering, without mingled feelings of pity, thankfulness for all our own good things, and an eagerness to be kind and generous? That is the spirit in which to sit down quickly and write out a cheque for the I.E.E. Benevolent Fund or the E.T.B.I. Fund, or perhaps to remember both!

Cable Manufacturing "Conversations."

FOR several days last week there was exceptional activity on the Stock Exchange in shares of a number of well-known cable-manufacturing companies. Rumours were current which received a good deal of attention in the newspaper Press, and the public interest was such as to occasion substantial rises in values. Interest fell away on the Thursday of that week, and on the following day the extraordinary general meeting of W. T. Henley's Telegraph Works Co., Ltd., which had been convened for the purpose of making alterations in the Articles of Association which had controlled the company for 46 years, was held. The speech delivered at that meeting by Sir George Sutton, Bart., the chairman, we report in full in our "City Notes" to-day, in order that the reader may have as correct an idea as possible of the position. The word "amalgamation," which had been so freely used during the week, would not have occasioned so much activity if the market had ascertained that the company did not require additional powers for that purpose, as it had always possessed them. Sir George stated emphatically that Henley's had no proposal under consideration for the amalgamation of its business with others. Conversations, however, had been taking place between its directors and those of some other cable companies having for their sole object the possibility of lowering the cost of production, and of putting the English companies in a better position to secure export trade. By reducing production costs under some arrangement with competitors, turnover would be increased and prices to consumers further lowered. It was felt that every effort should be made to reduce the cost of electrical appliances, in order to promote a universal demand; the cable manufacturers would be contributing their share to that end. It is not proposed to reduce costs by lowering labour rates—although they are 40 per cent. higher than are prevailing on the Continent—but to improve output, bring about economies in overhead charges, and collaborate with other companies in the matter of research, thus securing efficient results from the investigations taking place in the individual laboratories of the different companies. Stated in a word, the elimination of wasteful expenditure is the main objective.

The interest that investors are taking in the electrical industrial securities market and in electricity supply companies which have been making their bonus declarations affords additional evidence of the high estimation in which the general public holds electrical investments. Whatever capital may be required for sound electrical enterprises can be secured to-day at a reasonable rate of interest. The eagerness with which the public snaps up various other kinds of issues that lack the merits that are afforded by the approaching period of widespread electrical development, is a sign that electrical enterprise need not be delayed by want of capital.

Electrical Refrigeration.

WE have frequently urged electrical contractors and dealers to give a prominent place in their progressive business campaigns to the sale of electrical refrigerators. Some have already found it a very satisfactory and remunerative line. During the next few years the turnover should be large, for in addition to the growth of the "ice habit" amongst us in all seasons of the year, there is the compulsion which is imposed upon food suppliers, wholesale and retail, to employ some form of refrigerator to preserve foodstuffs which under the new Order of the Ministry of Health must not contain certain preservatives. It had been thought that the Regulations would not come into force until the middle of 1927, but notice was issued on Monday last to the effect that the Order affects some foods as from January 1st, 1927, others as from July 1st, 1927, while yet other classes are not affected until January or July, 1928. Contractors everywhere should study the terms of the Order and push sales in what is a very promising class of electrical trade.

Electricity in Mines.

THE report of H.M. Electrical Inspector of Mines, Mr. J. A. B. Horsley, for the year 1925 (H.M. Stationery Office, price 6d. net)—which was issued last Friday, though dated May 26th, 1926—draws attention to the regrettable fact that the direct sales of the reports for 1923 and 1924, which like the present one were published separately at the low price of 6d., reached numbers far less than the number of mines equipped with electric power in 1924—namely, 1,630. It is not even clear that the bulk of the reports actually sold went to collieries. The Inspector leaves the question open whether the accessibility of the report is not generally known or whether the value of the lessons to be learned from the unfortunate experience of others is underrated; we should incline to the former alternative, as the latter is hardly credible, and the advertising efficiency of Government departments is not highly rated. Steps should be taken to secure the wider circulation of the reports, with a view to the adoption of the Inspector's suggestions for the prevention of electrical accidents in mines.

Large Modern Electric Cable Works.

The Woolwich and Gravesend Factories of W. T. Henley's Telegraph Works Co., Ltd.

(*Concluded from page* 986.)

The Gravesend Works.

THE factories at Gravesend (fig. 10) are also situated on the river Thames. The buildings in the left middle foreground comprise the wire-drawing and annealing shops, those immediately behind them being the Engineering Department's shops. The research building is the flat-roofed structure further behind these, close to the river bank; the buildings on the left comprise the vehicle-tire factory, while the building of six roof spans on the right is the cable factory. The latter is, in fact, one huge shop under a single roof and without internal obstructions or partitions; its lay-out was conceived with foresight to facilitate the entry of wire and insulating materials at one end, passing through various processes in turn, the machinery being arranged end-on in line, the products of the factory emerging at the remote end of the shop as finished cable. In this shop there are a 20-ton overhead electric travelling crane and seven 5-ton cranes serving five spans of the building.

The chief products of the Gravesend Works (under the management of Mr. R. O. Wright, M.I.E.E., A.M.I.Mech.E.), are paper-insulated power cable for pressures up to 60,000 volts and dry-core telephone cable. Copper "rod" of a diameter varying from $\frac{1}{4}$ to $\frac{1}{2}$ in. is received from the rolling mills (in which Messrs. Henley's Co. is interested) and "pickled" in a sulphuric acid bath, a cold cleansing process. The scale is then washed off by means of strong water sprays,

Fig. 10.—W. T. Henley's Gravesend Factories (View from Aeroplane).

the copper being reclaimed in settling tanks in the form of copper sludge, and from the acid tanks in the form of copper sulphate.

The next process is reducing the diameter of the cleaned copper rod by drawing it through a series of dies immersed in a liquid lubricant, numbering from one to nine or more per machine, the wire passing from one machine to another until it has been reduced to the requisite diameter. As fig. 11 indicates, in front of each die is a capstan round which the wire is coiled (to pull it through the die); each capstan revolves at a higher speed than its immediate predecessor, on account of the greater length (smaller diameter) of wire to be pulled through the die. All the larger machines are individually driven by electric motors.

The dies may be circular or shaped to produce various forms of wire; the larger sizes are made of chilled iron, the smaller of a diamond secured in a brass holder. As the die hole wears larger it is reground and used for drawing larger diameter wire, and when the diamonds finally break up they are crushed to powder and used to grind other dies.

The diamond dies are naturally expensive, some costing £40 each. The smallest diameter down to which wire is drawn is 0.001 in., the strands of "flex"

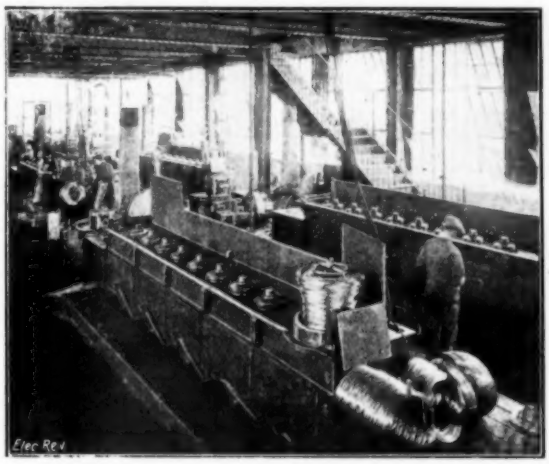


Fig. 11.—Part of the Wire-drawing Plant.

usually being 0.0076 and 0.0048 in. in diameter. Fig. 12 illustrates the drawing of fine wires for flexible cords, &c., in which process diamond dies are used exclusively.

To soften the hard-drawn copper wire thus produced, it is annealed at from 1,000 to 1,100 deg. F. The coils are carried through water seals on a conveyor into and out of the furnace, wherein is a neutral atmosphere to prevent oxidation. The Company has recently added a furnace of a newer type; it is electrically-heated and non-oxidising, and has the appearance of an inverted box mounted on rails over a pit filled with water. Two separate hydraulic rams, carrying platforms on which the copper wire to be annealed is stacked, are mounted in the tank in such a manner that the furnace chamber can be moved by hydraulic mechanism over each platform in turn, so that whilst one charge is being

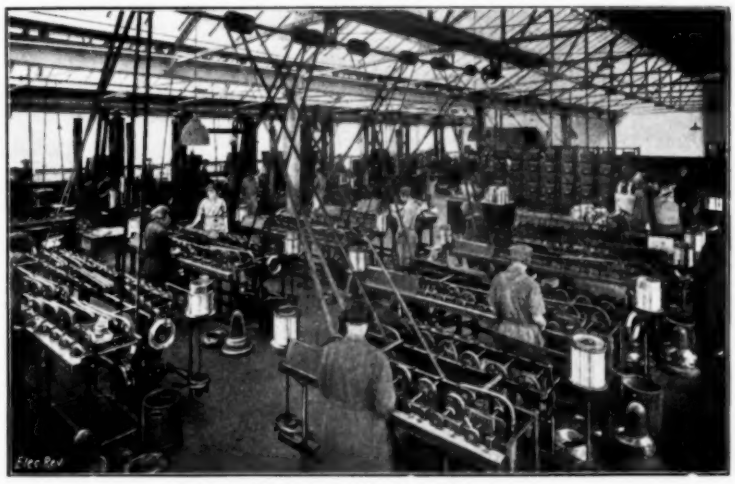


Fig. 12.—Fine Wire-drawing Machinery.

annealed by being raised into the chamber, the other platform is being unloaded and recharged with hard

copper wire. Greenwood & Batley battery-driven electric trucks are used for transport purposes in the shops.

For stranding the conductors the requisite number of wires is wound on to small drums which are suspended in carriages that revolve around the axis of the stranding machine, two of which machines are illustrated in

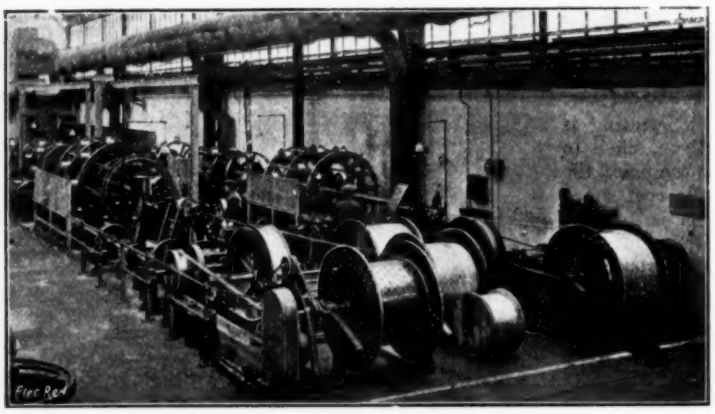


Fig. 13.—Conductor Stranding Machines.

fig. 13. The stranded conductor is formed by being drawn through the machine horizontally whilst the carriages revolve, and it is wound on the drums seen in the foreground, as it is completed. This is the principle on which all subsequent insulating processes are carried out; for instance, on the right of fig. 14 a paper-covering machine can be seen. As the stranded cable is drawn along, a number of bobbins on which paper strip is wound are revolved round it so that on the copper core is lapped the required number of layers of paper tape. Some of the machines can cover a conductor with 36 strips of paper simultaneously.

In the case of multi-core cable, the three (for example) individual stranded copper cores may be shaped triangular in section to fit snugly in a circular sheath. This operation is carried out by passing the cores through power presses with dies of segmental shape.

After the conductors have been paper-covered, they are "laid up" around a jute or paper centre with jute or paper "wormings" in the interstices of the cores. A typical "laying-up" machine is illustrated in fig. 15; the same machine puts on, over the three cores, the further necessary number of "coats" of insulating paper and, when required, copper tape to form the Board of Trade earth sheath in contact with the lead which is added by a subsequent operation. The drums of insulated cable are next placed in cylinders, wherein a vacuum is created, after which liquid compound is allowed to enter so as to be absorbed by the paper. The treatment and temperature naturally differ to suit the type and voltage of the cable, which is kept immersed in hot compound until just before being lead-covered. The sheath of lead is applied by drawing the cable through a press containing molten lead under pressure (fig. 16) which cools as it is extended, assisted by a water bath. After being lead-covered, the cable is lowered into the water tanks in which it is immersed for 24 hours before being tested and passed for armouring. The final process is the application of the armouring, galvanised-iron wire or steel tape, the lead sheath being first coated with compound and lapped with Hessian tape, or served with jute. After armouring, a further set of tests is taken; fig. 17 shows the power test floor with a high-voltage transformer in the foreground.

The above remarks apply to the making of power cable, but dry-core telephone cable is made in the same factory with the aid of similar machinery. The two kinds of cable differ chiefly in that the dry-core cable,

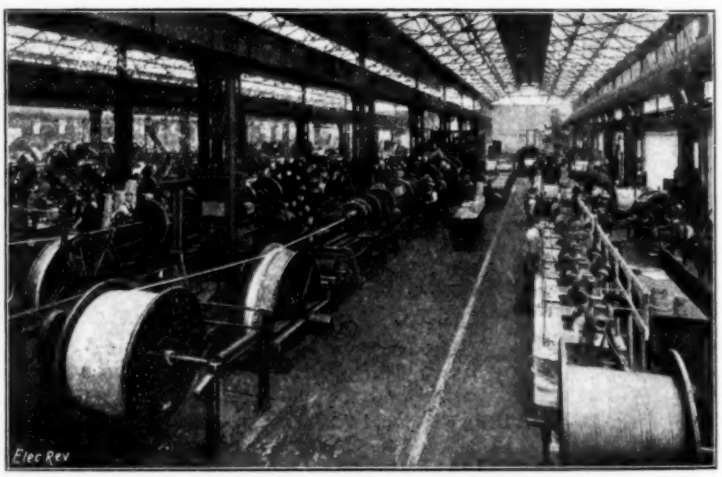


Fig. 14.—Paper Covering Machine (Right).

as its name implies, has to be specially dried and is, on completion, filled with air from which all moisture has been extracted, whereas the power cables, after drying, are impregnated with viscous compounds. Special care has to be exercised in the manufacture of this class of cable to ensure that pairs are properly balanced; this aim is achieved by utilising one length of wire cut in halves to form a twin, which is thus actually one rod drawn through the same set of dies under identical conditions. Two twins are made into a quad (four wires), and the latter are again cabled up as required; some laying-up machines are capable of handling 1,000 pairs each.

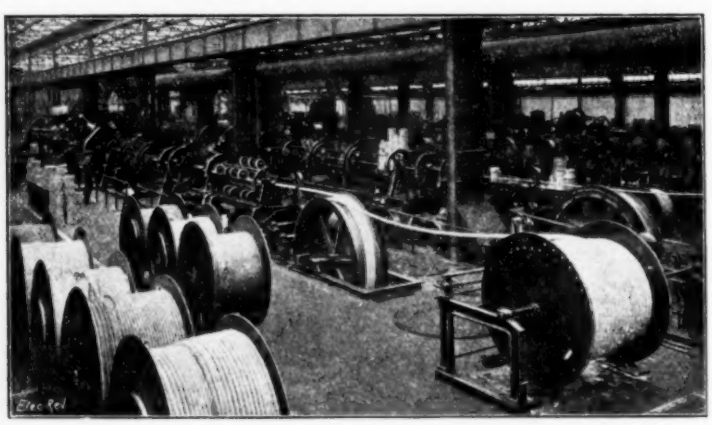


Fig. 15.—A Typical "Laying-up" Machine.

The works are, of course, electrically lighted and driven throughout; a.c. is purchased at 6,600 volts and the pressure reduced by works' transformers, and converted to d.c. by Bruce Peebles motor convertors. Boilers and gas engine-driven generators originally installed have been retained as stand-by plant, whilst the gas used for heating purposes is produced on the premises by Dowson

plant using anthracite coal. A large well-appointed canteen, served by an all-electric B. & K. kitchen, is daily patronised by the employés.

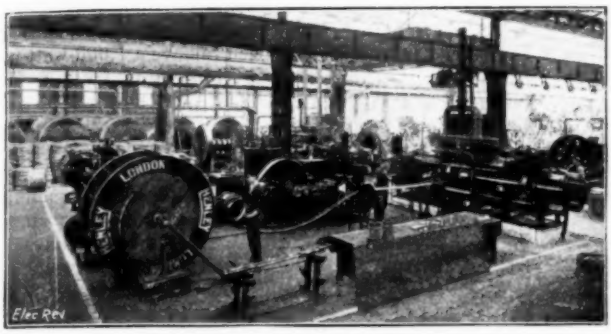


Fig. 16.—One Set of Lead-Covering Plant.

The Company's Other Activities.

The Engineering Department forms a considerable section of the Gravesend factory. Therein is produced all the special plant needed by the Company, including the cable-making machines, and a satisfactory feature noticed during an inspection of the works was the number of new machines of this class in course of installation at Gravesend.

The Company's engineering shops, though only a part of the whole factory, are of a size comparable with many complete works; they are well arranged. Underground cable junction boxes, "Ironclad" service cut-outs, distribution pillars, and fuse panels of the well-known Henley "Unit" type and link-disconnecting boxes built up of stock parts, are but a few examples of the products of the Engineering Department, which produces apparatus generally used in cable distribution systems, the Company claiming to be the largest maker of this class of material. The designers aim at dispensing with castings whenever possible and substituting therefor wrought copper, pressings, and sheet material, thus eliminating the possible existence of blow holes and improving conductivity and reliability. Allied sections are a foundry, spray-painting and enamelling shops, grinding and press shops, &c., well-planned stores and jig- and tool-making sections. Automatic machine tools are taken advantage of fully, as are also portable labour-saving devices.

Finally, Henley's Tyre & Rubber Co., Ltd., must be mentioned, the products of which include tennis and golf balls and pneumatic solid-band and air-cushion vehicle tires. Although space limitation has forbidden the cable-making processes being considered in any great detail, sufficient has been written to indicate the Company's varied activities and scope. That the Company recognises the fact that organised investigational facilities enable results to be achieved more rapidly and with certainty, is indicated by its establishment of an extensive Research Department.

We are indebted to the Company for the photographs reproduced in this article, no less than for the courtesy and assistance afforded us by its staff on the occasion of our tour of the works.

Fig. 17.—Power Test Floor: H.P. Transformer in Foreground.

A Progress Report on Standardisation and Research.

Drafted after a Christmas Dinner for I.E.E. *Journal* by a Panel of the Papers Committee, but rejected.

THAT engineers are too busy to read even one-tenth of one per cent. of the observations of their fellows is confirmed by the desire of the I.E.E. to publish a synopsis of abstracts covering the wide fields of standardisation and research. With a view to meeting this desire we beg to submit the following:—

It can be shown and proved to the last decimal at Wembley—not the late departmental store known as the B.E.E.—that it takes ten times as long to absorb the meaning of one page of letterpress (if, that is to say, it has any meaning, which only happens at rare intervals) as it does to grasp the idea behind a pictorial representation. This has been confirmed at Teddington. At Trafford Park (Manchester always being ahead) they have decided that in future it will be sufficient to publish photos of the foreheads of their investigators, the results of their work being transmitted without being relayed through the old-fashioned medium, printer's ink.

For these and many other reasons, the Panel decided that so far as possible its report should be pictorial. Desire has, however, to some extent, outrun ability.

A brief survey over the last decade will, it is confidently believed, justify the vision of those responsible for initiating the movement of standardisation and research. In no one thing is their foresight more apparent than in their almost inspired selection of the words "standardisation" and "research." It is certain that had they adopted the American term "simplification," the movement would have been stillborn. No one wants life to be simpler—the cry "The simple life" has no pep in it nowadays (the simple loaf has a much more definite meaning in these days of doles and depression).

Again, how ridiculous it would have been had they used the word "search." These great men of old knew that with the passing of their generation, real ability would cease and their successors would never find anything worth considering final. So, to keep our courage up they have sent the cry "research" resound-

ing through the ages as an encouragement for us to search and search and search again if at first we don't succeed.

The first illustration, fig. 1, shows the condition of affairs two decades ago. It is intended to depict

Fig. 1.

Mr. ———— Civil, Mechanical and Electrical Engineer and a Chemical Society Fellow, Consulting Engineer to the Rural District Council of ————, interrupted whilst correcting the final proofs of his specification of a 2-h.p. 110-volt motor for driving the pump in the village of ————.

To-day the scene has changed—a recent incident overheard in the waiting room of the Consulting Engineer (Doubly Chartered) to the Railways of the Southern Hemisphere, will indicate some of the benefits which have accrued from the work of the B.E.S.A.:—

Fig. 2.

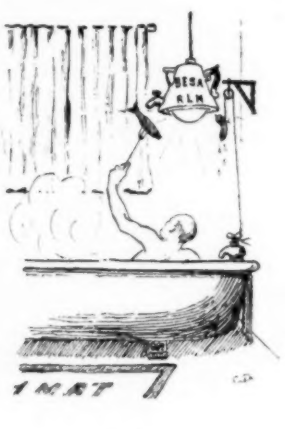


Fig. 3.

Fig. 4.

"Here, Jones, here's a commission to install a new railway from Tokio to Cape Horn. Just make up a specification using B.E.S.A. 18,124, 14,118, 286, 3,348, 6,741 to 8,420, with the B.E.A.M.A. business terms put in an appendix, the I.E.E. general conditions of contract to make it look respectable, and get quotations. I'll be back next week when the Golf Championship is over."

Like the workers in the time of the first industrial revolution, some of the older-fashioned real engineers are agitating for the suppression of these labour-saving devices, but the more thoughtful ones, remembering something of their early training, recognise that progress, having momentum, cannot be arrested without the expenditure of energy, are dismissing their chauffeurs (retaining the footman only), and are learning to drive their own cars so that during the transition period they can keep off the rates.

This record of progress would not be complete without reference to the successful termination of the campaign instituted by the I.M.E.A., and supported by the London companies, for the adoption of only one size of electric lamp. They desired to have a 1,000-watt lamp as the standard, and did not object to its being frosted, but general agreement has now been reached to standardise the 500-watt size as the one universal ubiquitous standard, a clear bulb being called for unless otherwise specified.

A very substantial reduction in the cost of manufacture of the lamps is certain as a result. The amount of the reduction passed on to the public (if any) will be determined by the E.L.M.A. At present the E.L.M.A. contend that it is low and mercenary to discuss selling prices, as the public will benefit in so many other ways. They say that, as so ably pointed out by Mr. Bush, since the new standard lamp was installed in his bathroom, a hot bath could be prepared whilst shaving, it only being necessary to attach a length of rubber hose to the cold tap and let the water run over the bulb (fig. 2).

Mr. Gaster, on the other hand, has shown how a really suitable (B.E.S.A.) intensive diffusive reflecting shade for these new standard lamps can usefully be water cooled, forming a kettle for his morning tea and at the same time, as the new standard lamp brings the water therein to boil, sausages and toast are effectively grilled by the delightful rays of which the 500-watt B.E.S.A. standard lamp emits a large number. Appropriate E.D.A. posters will be prepared to make the matter clear (fig. 3).

Well may the E.L.M.A. pocket all the proceeds and earn a better report the next time they are investigated by a Food Council.

Although there is no definite progress to report in regard to the matter of standardising speeds for motors, it is satisfactory to be able to say that every possible band of speeds has now been allotted, and there are no gaps for any new designer. It is hoped, therefore, that before long at least two firms will be making to the same speed standards. As a helpful action, the band of speed which up to now has been appropriated for the exclusive use of Government departments will be available to any British firm without further taxation. Licences will be issued at the local post office.

Calculating the size of a wire to connect a switch with a lamp and having it drawn specially to size is a thing of the past. There is unfortunately some distress among the workers in the copper industry as a result, but experience has shown this to be a passing phase—the I.E.E. benevolent fund is dealing with it. B.E.S.A. No. 7 (combined with the light and gentle guidance and control of the C.M.A.) has left no doubt that 1/.036 is the right size (or according to the I.E.E. Rules 3/.029), and the price of wiring has come down in theory as a result of this excellent piece of standardisation. In

practice, the newly decorated registered chartered (or is it chartered registered?) wireman must, of course, have emoluments on the higher scale, so the public is once more caught in the Webb of economic conditions.

Research, fortunately, is coming to the aid of the deserving public. Prof. Hairanbritebrain (exclusively financed for the past three years by the E.R.A., with altruistic help from an interested body) has at last seen the electric current flow. There are 10 billion of these perfectly formed mammals (fig. 4) in 1 mm. The results which will follow this marvellous piece of work cannot yet be appreciated (only British optical glass was used throughout the apparatus). The Professor is enthusiastic, and is confident that very shortly (with the aid of a further large grant from the E.R.A.—it is whispered largely supplied by the C.M.A.) he will have so tamed a species of the micro-micro-mocro fleas, as he has named the mammals (a committee of the I.E.C. will determine whether this should be called pico-pico) which form the electric current, that they will walk along any path desired without the use of a cable or wire to show them the way (*en passant*, the origin of electric shocks is now clear). A point not directly concerning the subject may be noted here: When the new era arrives we are informed that the C.M.A. will become amalgamated with the R.M.A. (formerly known as NARMAT).

Other developments may take place sooner—the Professor's assistant, Mr. Wattavolt, has discovered a counter-irritant so that after completion of their work the micro-micro-micro fleas (pico-pico) may be painlessly exterminated and so make it possible to dispense with the return lead.

Another interesting development, fathered by the E.R.A., is based on the work of the renowned Darwin and Mendel—so inextricably mixed are the sciences to-day. The work about to be described is being carried out by a Committee on electro-physical-biological-farming (the organic chemist will soon have to look to his laurels as the inventor of the most complex words).

The Committee, not feeling satisfied with the extent of the descent of man, has succeeded in evolving, by suitable selection of the common commercial spider (over 1,000,000 generations were developed before this result was obtained), a species which spins a web having a conductivity 140 per cent. of the I.E.C. standard of copper and by the same process the next 100,000,000 generations are expected to provide a web not only of 140 per cent. conductivity, but insulated with a very thin but perfect insulator.

The C.M.A. have offered to endow the E.R.A. in perpetuity if they can have control of the blood stock of these spiders.

The N.E.C.T.A. have decided to engage the services of a professional trainer (Bostock's son has applied for the post) with a view to training these spiders to walk through the conduits (Tubes, Ltd., having already agreed to coat the inside of all conduits made under their control with a choice fly at intervals so as to secure rapid drawing-in) and the Wiring Rules Committee has decided to appoint a committee of the whole of its members as a New Wiring Rules Committee to draft a few volumes of rules to cover the conditions likely to arise as a result of these far-reaching discoveries. The Albert Hall has been booked for the meetings of the Committee, and for those unable to get in, the B.B.C. will remedy the defect.

It is confidently anticipated that progress during next year will be at a still greater rate, as larger quantities of the medicinal drug known botanically as Besacomitatus Nicotina have become available. The drug itself is a wonderful counter-irritant, and the effect even of small quantities is to promote a desire to visit London for converse with those undergoing the same treatment—and for other well-known reasons.

A New Swiss Electricity Project.

A Scheme for Utilising the Water-Power of the Oberhasli.

(From Our Own Correspondent.)

ENGINEERS who have spent their all-too-short summer holidays climbing in Switzerland will be interested in hearing a little about the new hydro-electric works under construction by the Forces Motrices Bernoises. This go-ahead company, finding that its supply of electricity is insufficient to meet its ever-growing needs, has now adopted plans for utilising the water power of the Oberhasli, with the two little glacier lake beds of the Grimsel and the Gelmer as reservoirs, feeding from the falls of the Aar. The rock tests have proved satisfactorily that the lake-beds are of pure granite, while the valley to be dammed by the barrage of the Spitallamm is equally the result of glacier-erosion, presenting absolutely no fissure whatever, so that geologically no finer position has ever been presented for a hydro-electric power station than that of the Oberhasli.

The waterfall of the Aar, available as far as Innertkirchen, is about 1,200 metres, and it will be divided into three consecutive stages or falls—one from the Grimsel to the power station of the Handeck, the second from the Handeck to Boden, and the third from Boden to Innertkirchen. The mean fall of the first section is 545 m., the machinery installed will be of 100,000 h.p., and the energy available annually will be 223,000,000 kWh, registered at Innertkirchen. For the second the figures are: 417 m. fall, 86,000 h.p. of machinery, and a permanent output of 190,000,000 kWh per annum. The third stage has a mean fall of 248 m., machines capable of furnishing 60,000 h.p., and at the least is capable of an annual output of 125,000,000 kWh.

All the works for the first part of the Oberhasli plan will be founded upon and carried out in granite, but the principal barrage of the Spitallamm (100 m. high, 180 m. wide across the gorge, and with 340,000 cu. m. of masonry), as well as the auxiliary barrage of the Seeuferegg, will naturally be built of reinforced concrete. The first barrage takes the form of a curved resistance wall, and the second a straight one; the construction of both will be much facilitated by the inexhaustible quantities of sand and granitic gravel lying handy in the bed of the Aar. The crown of the Seeuferegg, 290 m. long, will be put into use as a short cut from the new Grimsel road to the hospice which is to be built on the Nollen, and to the hut of the caretaker of the barrage. The Grimsel lake will hold 100,000,000 cu. m. of water, and the Gelmer lake 13 million cu. m.; the barrage of the Gelmer is to be 385 metres long, and immediately after the water leaves the lake it descends by a series of falls to the plain of Handeck 400 metres below.

A pressure-pipe, 5,250 metres long, set entirely in the right-hand face of the granite rocks of the mountain, conveys the water from the Grimsel lake, and a high-pressure gallery 375 metres long carries the water from the Gelmer lake to a reinforced iron-clad penstock, which vertically for 300 metres, and then obliquely, supplies the water to the turbines at a rate of 18 cu. metres per second. The power house is situated on the right bank of the Aar, above the zigzags of the Handeck; its foun-

dations are hewn out of the granite rock, and it is protected from avalanches by a protruding mass of rock. This central station will have four vertical Pelton turbines, each developing 25,000 h.p. at 500 r.p.m. The alternators, with a normal capacity of 25,000 kVA, will generate three-phase current at 7,500 V, which will be transformed to 50,000 V for transmission.

Although the Handeck is not so very high, it is uninhabitable for part of the year, because the valley below as far as Guttannen is very narrow and sometimes obstructed by avalanches, so that overhead transmission cannot be used. To overcome this difficulty a gallery has been pierced in the rock on the left side of the valley, large enough to allow the men employed at the Handeck power house to go down to the village of Guttannen without running any risk of being overtaken by an avalanche. The electric cables are placed in this gallery, thus ensuring the regular transmission of energy in all seasons. Lower than Guttannen no further precautions are necessary, and overhead wires carry the current on to Innertkirchen.

Engineers, electrical or otherwise, visiting the Bernese Oberland or the Rhone Glacier could do worse than tramp a bit farther and see for themselves the work in course of construction in the Oberhasli. They may be sure of a hearty welcome from their Swiss *confrères*, who do not always find life very gay in that land of snow and ice so far above the plain.

Some Notes on Reversible Potentiometer-Type Field Rheostats.

By THOMAS CARTER, M.Inst.C.E., M.I.E.E., Fel.Am.I.E.E.

THERE are occasions when the current in an electrical circuit, as, for example, in the field winding of a hand-regulated reversible booster, has to be varied from a maximum in one direction, through zero, to a maximum in the other direction; and if a three-wire, direct-current supply is available, the requisite variation can be obtained conveniently by means of a potentiometer-type field rheostat in the manner shown diagrammatically in fig. 1. If F is the coil or other circuit in which a variable current is required, the setting of the movable contact-arm of the rheostat at the left-hand end of the contacts will connect F across V_1, and will thus produce the maximum current in F in the direction from the contact-bar of the rheostat to the intermediate wire of the supply. Conversely, the setting of the contact-arm at the right-hand end of the contacts will connect F across V_2, and will produce the maximum current in F in the opposite direction, that is, from the intermediate wire of the supply to the contact-bar. The potential of the contact-bar assumes values between that of the positive outer and that of the negative outer as the contact-arm is moved from left to right over the contacts and along the bar; at some intermediate point the potential will be the same as that of the intermediate wire of the supply, and no current will flow in F; and the arrangement therefore gives the required variation, with a fineness depending only on the number of contacts provided in the rheostat.

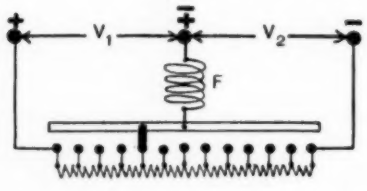


Fig. 1.

To examine the current relations in the several parts of the circuit, from which the carrying capacity of the potentiometer resistor is determined, take first of all a quite general case, as shown in fig. 2. Let V_1 and V_2 be two differences of potential, maintained constant, but not necessarily equal; let R_1 and R_2 together make up the resistor; and let R_3 be the circuit in which the variable current is required. C_1 and C_2, the currents in R_1 and R_2 respectively, always flow from left to right under the conditions shown in fig. 2; but C_3, the current in R_3, flows upwards when the movable contact-arm is near the positive outer, and downwards when it is near the negative outer, becoming zero at some intermediate point.

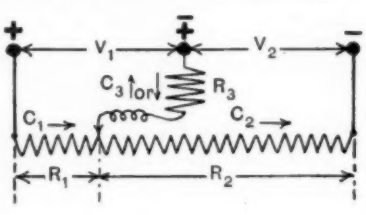


Fig. 2.

Now examine the equations of the circuit.

$$C_1R_1 + C_2R_2 = V_1 + V_2.$$

But $C_1R_1 + C_3R_3 = V_1$ .....(1).

Hence $-C_2R_2 + C_3R_3 = V_2$ .....(2).

$C_1 - C_2 - C_3 = 0$ .....(3).

It must be remembered that C_3 may be intrinsically negative, as well as positive, relative to the fixed direction of C_1 and C_2; but the three equations (1), (2), and (3) are quite general in form, and it will be seen in the result that they cover the full range of values of C_3 from its positive maximum, through zero, to its negative maximum. Operations on the equations give the following:—

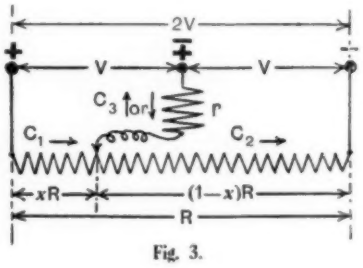


Fig. 3.

Multiply (3) by R_1, and subtract the product from (1): then $C_2R_1 + C_3(R_1 + R_3) = V_1$.

Multiplying this result by R_2, and subtracting R_1 times (2) from it, gives

$$C_3(R_1R_2 + R_2R_3 + R_3R_1) = V_1R_2 - V_2R_1$$

Hence, if ΣR_1R_2 denotes $R_1R_2 + R_2R_3 + R_3R_1$,

$$C_3 = (V_1R_2 - V_2R_1)/\Sigma R_1R_2.$$

Substituting this value of C_3 in (1) gives

$$C_1R_1 + (V_1R_2 - V_2R_1)R_3/\Sigma R_1R_2 = V_1.$$

Hence, after simplification,

$$C_1 = \{V_1R_2 + (V_1 + V_2)R_3\}/\Sigma R_1R_2.$$

C_2 is then found by subtracting C_3 from C_1, since, according to (3), $C_2 = C_1 - C_3$.

Thus $C_2 = \{V_2R_1 + (V_1 + V_2)R_3\}/\Sigma R_1R_2$.

It is clear from these expressions for the values of the three currents that, when $R_1 = 0$, $C_3 = +V_1/R_3$; when $R_1/R_2 = V_1/V_2$, $C_3 = 0$; and when $R_2 = 0$, $C_3 = -V_2/R_3$. This merely states symbolically what has already been shown, that C_3 has values passing from a positive maximum, through zero, to a negative maximum, when the circuit is arranged as has been described.

Now assume that the supply is from an ordinary three-wire, direct-current system, as shown in fig. 3, with 2v volts across the outers, and v volts on each side of the system. Let R be the total resistance of the potentiometer resistor, connected across 2v volts, and

r the resistance of the circuit carrying the variable current. The value of r is fixed for any given case: let R be n times r, where n is a numerical multiplier. R is divided into two parts, xR and $(1-x)$R, by the movable contact-arm, and, as this passes over the contacts, xR, at first zero, increases in value, while $(1-x)$R, at first a maximum, diminishes, finally becoming zero. Since R$=nr$, xR$=nxr$; and $(1-x)$R$=n(1-x)r$. If these values are substituted in the expressions for c_1, c_2, and c_3, obtained above, the values of the currents

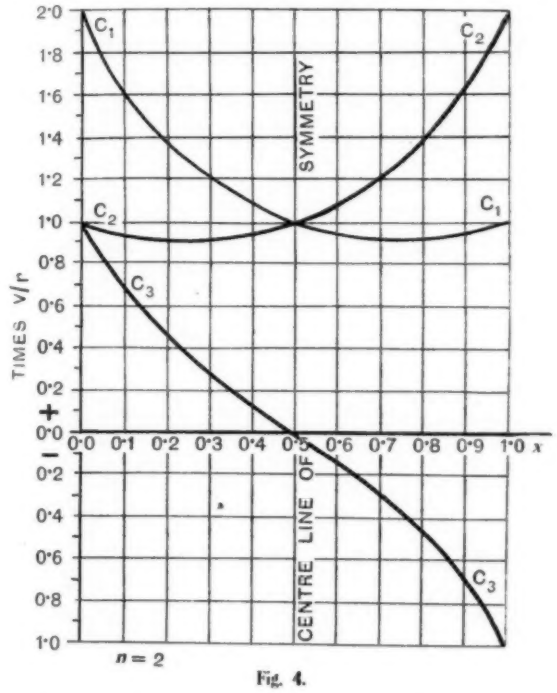


Fig. 4.

will be stated in terms of v, n, x, and r. The denominator of all the expressions, ΣR_1R_2, becomes $nr^2(1+nx-nx^2)$, and the general expression for c_1, namely,

$$c_1 = \{v_1R_2 + (v_1 + v_2)R_3\} / \Sigma R_1R_2$$

becomes, after substitution and simplification,

$$c_1=(v/r)(1+2/n-x)/(1+nx-nx^2).$$

Similarly, $c_2=(v/r)(2/n+x)/(1+nx-nx^2)$,

and $c_3=(v/r)(1-2x)/(1+nx-nx^2)$.

Thus, for any given case, the currents can be expressed at each point as numerical multiples of v/r, and their values can be plotted against x for values of x from zero to unity.

When $x=0.0$, $c_1=(1+2/n)v/r$; $c_2=(2/n)v/r$; and $c_3=+v/r$.

When $x=0.5$, $c_1=(2/n)v/r$; $c_2=(2/n)v/r$; and $c_3=0$.

When $x=1.0$, $c_1=(2/n)v/r$; $c_2=(1+2/n)v/r$; and $c_3=-v/r$.

This shows that there are three values of c_3 that are always independent of the value of n, that is, of the value of R, and the only thing affected by n is the precise course of the curve by which c_3 passes from its value v/r to its value zero. Analytical inspection of the expressions for c_1 and c_2 shows that, for every value of n, these are reflections of each other in the vertical line through $x=0.5$, and that, also for every value of n, the curve by which c_3 passes from $+v/r$ at $x=0.0$ to zero at $x=0.5$ is repeated in shape, but reversed in sign, as c_3 passes from zero at $x=0.5$ to $-v/r$ at $x=1.0$. That is to say, the vertical line through $x=0.5$ is a centre of symmetry of the curves.

Since, then, the curves are of the same general character for all values of n, it will be sufficient to plot one set as typical; and fig. 4 shows these for $n=2$.

$$c_1=(v/r)(2-x)/(1+2x-2x^2).$$
$$c_2=(v/r)(1+x)/(1+2x-2x^2).$$
$$c_3=(v/r)(1-2x)/(1+2x-2x^2).$$

The x-functions are plotted against x, between $x=0.0$ and $x=1.0$, and show the three numbers by which v/r must be multiplied, at any position of the movable contact-arm, to give the values of the three currents, c_1, c_2, and c_3. The rating of each part of the resistor is determined by the greatest current that can ever pass through it, and since each part carries c_1 when it is to the left of the movable contact-arm, and c_2 when it is to the right, the rating at any point must suit whichever of the two currents may be the greater at that point. Hence the resistor must be designed to carry the currents shown in the curve for c_1 at points to the left of the centre, and those shown in the curve for c_2 at points to the right of the centre. That is to say, the current for which the resistor must be graded varies from $2v/r$—generally, $(1+2/n)v/r$—when the contact-arm is next to the positive outer, down to v/r—generally, $(2/n)v/r$—when it is at the centre, and up again to $2v/r$—generally, $(1+2/n)v/r$—when it is next to the negative outer; and the grading is symmetrical about the centre of the resistor.

The greater the value of n, the greater will be the value of the resistance of the potentiometer resistor, but the less will be the current it has to carry. If it is essential that the overall size of the rheostat should be kept small, some further investigation is necessary to determine the value of n at which this will be a minimum. The answer to a question of that kind cannot, however, be obtained from theory, except very generally, because of its dependence on such things as sizes of wire available, means for disposing the wire to the best advantage, and the necessity of using standard parts in construction. So, the general principle having been laid down, particular applications may be left for individual designers to work out.

Latin-American Markets.

Prospects for British Manufacturers.

By GERALD H. DENNY.

THE present position in South American markets, in so far as it affects British manufacturers of electrical goods, whilst not so satisfactory as it might be, is certainly full of promise. Some of the industrial difficulties of the past year, culminating in the disastrous coal dispute, have had their inevitable reaction upon export trade, and have rendered more difficult for the time being our post-war task of meeting the fierce competition of rivals less burdened by taxation and high cost of production.

Whilst it is true that British goods are held in high esteem throughout the Latin-American Republics, it is also true that the price factor must needs operate adversely to an appreciable extent. British goods are not going to "sell themselves," merely because they are "British and Best," when the products of other countries, superficially similar to the uninitiated, may be obtained at a considerably lower price. Where it is not possible to compete upon a basis of price, it is imperative that quality should be emphasised by means of judicious propaganda in suitable media. The average South American is luxury-loving; he (and she) like the best and will pay for it, but they must be assured that the article for which they are paying a comparatively high price justifies the expenditure.

There are still many manufacturers who persist in regarding even a large and important market like Argentina as a side show, whilst smaller Republics are regarded as if they did not possess a separate entity and their own special local conditions. The fact is that every Latin-American country constitutes a different market, has its own peculiar local conditions, and requires careful individual attention. No manufacturer can hope to do a thriving business with any part of South America unless he is prepared to give to it the same painstaking attention as he would naturally give to the requirements of the Home market. The situation in Argentina at the present time is not so bright as it has been during the past two years. The Republic appears to be passing through one of its periodical economic crises—the last one was in 1914—and wise exporters will scan their credits extremely closely. The Republic is fundamentally sound, and it is not too much to expect that normality will be regained within a reasonable period prior to another of its usual cycles of prosperity. In spite of intense foreign competition, there is no doubt that Argentina, with her immense undeveloped resources and rapidly-expanding population, still offers wonderful possibilities to the British manufacturer who will take the trouble to understand the psychology of the people with whom he is trading, or will adequately support his local agent who possesses that knowledge. The selling of goods is more important than the production of them, and calls for attention to business detail, local conditions and requirements, and carefully-planned propaganda. Old-established exporters to South American markets, as a rule, pay punctilious attention to these matters, but there are many others who might profit by doing the same.

A matter quite often neglected is the necessity for the rendering of all catalogues, price lists, and publicity matter in the language of the countries in which business is being done—that is to say, Portuguese in the case of Brazil, and Spanish so far as the rest of the South American continent is concerned. Even where this is done, complaints of imperfect translations are constantly being made. It must be understood that Latin-American Spanish differs very considerably from the pure Castilian of Spain. Furthermore, local peculiarities are to be found in different Republics. Quite good Spanish words are never used in some Republics and are not understood. Frequently different words are used in neighbouring Republics to describe the same article. It follows, then, that the manufacturer of electrical goods, trading with (say) Argentina should employ a translator perfectly familiar with the idioms of that country. This necessity is emphasised by the fact that it has been found expedient to publish in Buenos Aires a special dictionary of local idioms.

Although the visit of the Prince of Wales to Argentina last year was an excellent piece of collective publicity for British manufacturers in general, it is doubtful if it will have any real permanent effect upon the volume of British trade with that country unless individual manufacturers perform their part by seeing to it that the price and/or quality of their goods are right. It must be remembered that Argentine buyers are confronted by a bewildering assortment of goods from all parts of the world. There is no doubt that sooner or later British manufacturers will have to devote a great deal more attention to propaganda in this market than they have done in the past. The Argentine public is very responsive to the advertising of branded goods so long as that advertising is prepared with due consideration for the temperament of the people. Our competitors are losing no opportunity of gaining all the possible new business that publicity can bring them. Furthermore, a well-advertised line that is not being sold direct through a branch office is bound to be stocked by local houses.

The imports of electrical goods into Argentina remain fairly constant so far as rival supplies are concerned. The principal items, in their order of importance, are electric wire and cables, dynamos and electric motors, insulating tubes, electric batteries, metal or material for cells, insulators, electrical material and accessories in general, and incandescent lamps. In electric wire and cables German and British manufacturers hold the trade, the former leading slightly. In batteries, Americans practically monopolise the market, which is mainly for automobile types. In dynamos and electric motors, German manufacturers supply over 50 per cent. of the trade. In insulating tubes British firms hold the lead, followed closely by German manufacturers who specialise in "Bergmann" tubing. British manufacturers also hold the lead in supplying material for cells or storage batteries, which are mainly used by the British railways. In porcelain insulators Germany supplies 80 per cent. of the trade. Lamps come from Holland and the United States. Electrical material and accessories in general are divided between German, American, and British manufacturers.

In spite of the growth of the Argentine market for electrical machinery and material, conditions have been very discouraging for the increase of the British share, in consequence of German competition. Here, again, the chief reason is price, German makers even having been able to outbid others in insulated cables and wires. But Germany in this case has other advantages, in the shape of German ownership of most of the electrical supply companies, and the absence of modern wiring regulations in Argentina which permit the use of cheap and low-standard materials; further, there are large and well-known local branches of the German electrical trade and industry which carry stocks, give technical service, and whatever may happen in Germany, have always been willing to grant most extended credit terms in this trade. While Germany has secured the large Government contracts and also supplies the trade, British manufacturers are better placed for securing orders from British enterprises operating in the Republic, and should do everything possible to cultivate this connection.

The situation in Brazil, at the present time, may be described as a combination of fluctuating exchange, high prices, and increased taxation. Customs duties are very high, which means that imported articles are excessively dear. Customs regulations are strict and complicated, and the slightest divergence from rule entails vexatious delays, warehouse charges, and other unprofitable consequences. The question of securing effective representation in Brazil is a matter requiring considerable attention. It must be remembered that it is an immense country, and competent observers on the spot are agreed that effectively to cover so vast an area is beyond the powers of a single representative situated in Rio de Janeiro or Sao Paulo. The most satisfactory method is to sub-divide the country into definite areas and appoint in each a separate agent with a special knowledge of his own district. Generous credit terms (say drafts at from 30 to 120 days' sight) are imperative if any considerable volume of business is to be done.

Allusion has again been made by the President of the Republic to the urgent necessity of electrifying the suburban portion of the Central Railway of Brazil. Under existing conditions it is impossible to increase either the number of trains or the number of cars in each train. At the busy hours of the day the carrying capacity of the trains "is exceeded by 100 per cent. up to 150 per cent., and this has caused disasters and deaths owing to the accumulation of people on the platforms of the cars." This statement by the President by no means exaggerates the existing conditions of affairs.

With the increasing use of electricity in Brazil, the demand for domestic electrical appliances shows every sign of steady development. The most popular appliances at present are those imported from the United States. German products have not a wide demand, owing to their inferiority. The following is a brief outline of the nature of the demand for domestic electrical appliances in this market:—*Toasters.*—There is a steady demand, especially among the foreign ele-

ment of the population. Numerous designs are to be found on the market. *Coffee percolators.*—Brazil is, of course, a great coffee-drinking country, but owing to obedience to traditional methods of making coffee, percolators are not universally used. *Electric irons.*—There is a steady market, as the native domestic takes readily to them. *Curling tongs.*—There is a fairly steady demand for these. *Grills, disk stoves, and hot-plates.*—There is a steady demand which promises to grow. *Electric stoves.*—Owing to climatic conditions in Brazil, there is practically no market for electric stoves for heating purposes, or for radiators. *Cooking ranges.*—The use of gas is practically universal, and supplies are still fairly cheap, so that there is little demand for electric cooking ranges. *Electric refrigerators.*—There is a small but growing request for cheap and efficient refrigerators in Brazil. A few German makes are on the market, but there is plenty of scope for the introduction of improved and more expensive makes.

It may be of interest to mention here the voltages obtaining in the most important Brazilian cities. These are:—Rio de Janeiro.—Lighting: 120 V single phase, 50 cycles; power: 220 V three phase, 50 cycles. Sao Paulo.—Lighting: 120 V single phase, 60 cycles; power: 220 V three phase, 60 cycles, to a maximum of 2,200 V, 60 cycles. Porto Alegre.—Lighting and power: 220 V d.c. Bello Horizonte and Juiz de Fora.—Power: 220 V three phase, 60 cycles; lighting: 220 V single phase, 60 cycles. Pernambuco.—Lighting: 120 V single phase, 50 cycles, and 220 V three phase, 50 cycles; power: up to 3 h.p., 220 V three phase; over 3 h.p., 440 V three phase. Ceara.—Lighting: 220 V to 230 V d.c.; power: up to 1½ h.p., 230 V; over 1½ h.p., 550 V d.c.

The duty on electric irons, stoves, grills, and similar apparatus imported into Brazil is approximately 15 per cent. of invoice value. For more complicated apparatus, such as generating sets and refrigerators, duties cannot acurately be determined without a detailed specification of component parts.

Chile is a market of price rather than quality, but goods can be sold on a quality basis with the aid of first-class propaganda and efficient selling methods. The United States realises the situation to the full and conducts a vigorous and expensive "Buy American Goods" campaign, which frequently overcomes the handicap of price.

Remarkable progress in the way of internal development has taken place in Peru, and the expansion of this Republic makes it increasingly important as a market for British goods. Good main roads are being built which will open up large stretches of new territory. Perhaps the most important feature has been the completion of the Argentina-Bolivia-Peru Transcontinental Railway—an event which portends a new era of increasing prosperity.

Whilst not, in any way, minimising the opportunities awaiting British manufacturers in the larger and more exploited Republics, it is the considered opinion of the writer that more attention should be paid to the smaller countries in which world competition has not yet become intense. Argentina, for example, is the most highly competitive market in South America, and demands of the manufacturer who enters it for the first time a very high degree of efficiency in his selling methods and propaganda. The same criticism applies also to Brazil and Chile. By way of conclusion, then, one may summarise as follows: In spite of industrial disorganisation at home, and a consequent inability to compete upon a basis of price in South America, there is no reason why British manufacturers of electrical goods should not consolidate the connections that they at present possess and, at the same time, obtain further business—particularly in the smaller and less exploited Republics. This can only be done by studying the needs of each individual market more closely than has hitherto been the case, and by studiously supplying those needs. The old, conservative methods of trading are nowadays useless in Latin-America. Generous credit must be granted after careful inquiry has been made, modern selling methods must be adopted, and the absolute necessity for adequate propaganda must be realised as earnestly as it is undoubtedly realised by our principal competitors in all South American markets.

The Work of the Electricity Commissioners.

Report for the Year 1925-26. *(Abstract.)*

THE sixth annual report of the Electricity Commissioners, covering the period from April 1st, 1925, to March 31st, 1926, was issued last week (H.M. Stationery Office, price 3s. net). It states that the outstanding feature of the period was the announcement by the Prime Minister in January, 1926, of the proposals of the Government with regard to electrical development, followed in March by the introduction of the Electricity (Supply) Bill, 1926, into Parliament, and by the publication of the Report of the Committee presided over by Lord Weir of Eastwood.

After outlining the main provisions of the Bill, the Commissioners say that while the report of Lord Weir's Committee was under consideration and the Bill in process of formulation, they "were necessarily influenced in the exercise of their duties to avoid any course of action in connection with the reorganisation of supply under the provisions of the Act of 1919, which was likely to bring about results not in conformity with the policy of the Government. In these circumstances, questions relating to schemes of transmission and schemes of control of interconnected generating stations in certain electricity districts were deferred by the Commissioners for further investigation at a later stage in the light of the Government proposals, and a similar course was followed in the case of some of the more important applications made to the Commissioners for consent to proceed with the establishment of new generating stations.

"With regard to other aspects of electrical development which were not affected to the same extent by the impending legislation, such as the inauguration and extension of distribution works, the year under review was marked by considerable activity and by a general increase in the number of applications for Orders, consents and approvals under the Electricity (Supply) Acts."

On March 31st, 1926, the number of authorised undertakers in Great Britain was 596, comprising 356 local authorities (including 3 joint boards), 238 companies and persons, and 2 joint electricity authorities. The figures show a net addition of 28 during the year. The number of separate undertakers was 593.

Generation of Electricity.

During the year ended March 31st, 1926, the generated output of the local authority undertakers (270 stations) was 1,358,880,531 kWh; companies (213 stations), 2,329,988,396 kWh—total for authorised undertakers (483 stations), 6,698,868,927 kWh. The output of railway companies (52 stations) was 657,381,282 kWh; tramway authorities (26 stations), 371,750,463; non-statutory undertakings (23 stations), 394,961,151 kWh, bringing the grand total (584 stations) up to 8,122,961,823 kWh.

The consumption of coal was 8,263,880 tons; and coke breeze, 142,876 tons—total, 8,406,756 tons; oil fuel amounted to 38,810 tons. The output showed an increase of about 9.5 per cent. on the previous year, and the coal and coke consumed increased by 5.2 per cent., but the consumption of oil fuel decreased by more than 28 per cent.

As compared with 1921, the year's results showed increases of 57.2 per cent. in output and 14.2 per cent. in coal and coke consumed.

Five stations generated over 200 million kWh each, nine over 100 millions, and 32 over 50 millions; but of the 584 stations dealt with, 256, or 43.8 per cent., generated less than 1,000,000 units each during the year, and 428 stations, or 73.2 per cent. generated less than 10,000,000 units each.

The number of stations was the same as in the previous year, the exclusion of 20 stations at which local generation was discontinued being counterbalanced by the inclusion of 20 other stations which came into operation on or after April 1st, 1925. The latter include the Barking station of the County of London Electric Supply Company, Ltd., the Agecroft station of Salford Corporation, and the North Wilford station of Nottingham Corporation.

Consumption of Electricity.

Particulars are given in the Report with regard to the sale of electricity in Great Britain by authorised undertakers for the year ended December 31st, 1925, together with comparative figures for preceding years. In 1925 local authority undertakers sold 3,523,315,543, and company undertakers 1,992,029,821 kWh; total 5,515,345,364 kWh. The figures show that the sales of electricity by authorised undertakers have increased by 51.3 per cent. since 1922.

On the basis of the estimated population of Great Britain in 1925, namely, about 44 millions, the units sold by authorised undertakers in that year thus represented an average consumption of the order of 125 units per head of population. This figure does not take account of the supplies utilised for traction purposes and generated at the stations of railway and tramway authorities, or of the further large supplies generated privately at stations belonging to industrial and commercial organisations, and accordingly provides a partial measure only of the *per capita* consumption of electricity.

Reorganisation of Electricity Supply.

At the end of the period covered by the Report, schemes for the improvement of the organisation for the supply of electricity in eight electricity districts had been approved by Parliament, and had come into force. Two of these schemes were approved by Parliament subsequent to April 1st, 1925, being in respect of the London and Home Counties Electricity District and the West Midlands Electricity District. Approximate analyses are given for each of the eight electricity districts, showing the population and extent of (*a*) the areas within which supplies of electricity for *all* purposes are available or authorised; (*b*) the further areas, within the statutory limits of power companies, in which supplies for power purposes only are actually or potentially available; and (*c*) the areas composing the remainder of the district.

The eight districts are the following:—South-East Lancashire; South-West Midlands; North Wales and South Cheshire; Mid-Lancashire; East Midlands; Edinburgh and Lothians; London and Home Counties; and West Midlands. Proposals were put forward by the Conference of Local Authorities of the West Riding (Aire and Calder) Electricity District for the establishment of a Joint Electricity Authority, but the Commissioners found it necessary to defer action until the bearing of the Government proposals upon the future development of the District could be more clearly foreseen. Numerous applications for authority to distribute electricity were received, and eventually the Commissioners decided that the development of distribution could no longer be deferred, and accordingly proceeded with the consideration of the applications on their merits. Proposals which they put forward for the interconnection of the principal generating stations in the District were not approved by the local authorities concerned, and the Commissioners decided to defer consideration of the question until Parliament had dealt with the Electricity Bill. The same course was followed with regard to other Electricity Districts which had not been finally determined.

Generating Stations and Main Transmission Lines.

The aggregate capacity of the generating plant for new stations and extensions of existing stations sanctioned by the Commissioners during the year amounted to 585,700 kW, showing a substantial increase on the figure of approximately 480,000 kW recorded for the previous year.

Of the 2,821,693 kW of generating plant sanctioned during the past six years, 473,110 kW, or approximately 17 per cent., was for new stations, and 2,348,583 kW, or 83 per cent., for the purpose of extending or remodelling existing generating stations. The division of the total for the six years as between the various authorities was approximately as follows:—Local authority undertakers, 60.5 per cent.; company undertakers, 32.5 per cent.; and railway and tramway authorities and non-statutory undertakings, 7 per cent.

During the year the Commissioners issued 16 consents (10 to authorised undertakers and 6 to non-statutory undertakings) in respect of the establishment of new generating stations, representing the initial installation of plant having a total rated capacity of 46,460 kW.

During the year consents to the extension of existing generating stations were given by the Commissioners to 76 authorised undertakers, and 13 railway and tramway authorities and non-statutory undertakings. The sanctioned extensions represent, in aggregate, a plant capacity of approximately 539,200 kW, as compared with the figure of 463,200 kW for the preceding year, the division of the total as between the various authorities being approximately as follows:—Local Authority undertakers, 218,300 kW; company undertakers, 292,200 kW; railway and tramway authorities, 28,000 kW; and non-statutory undertakings, 700 kW.

As in the previous year, the Commissioners dealt with a number of important applications for consent to the establishment of main transmission lines. They issued formal consents in respect of 42 applications. Sixteen of the consents related to 33,000-volt transmission lines, and one consent related to 66,000-volt lines, the undertakers in the latter case being the Newcastle-upon-Tyne Electric Supply Co., Ltd.

(To be continued.)

The Electricity (Supply) Bill.—V.

The Lords' Amendments Reviewed by the Commons.

ON December 13th and 14th the House of Commons considered the Lords' amendments to the Electricity (Supply) Bill.

The first amendment on which discussion took place was the following new sub-section, which the Lords proposed to add to Clause 2 (General powers and duties of Board):—"(3) Where proposals are made to the Board by any association of owners of generating stations which, by virtue of this Act, become selected stations within an area for which a scheme has been adopted under this Act for the delegation to the association of any powers and duties of the Board within that area, then, if the Board are satisfied that the association making the proposals is a fit and proper body to carry out those powers and duties, the Board shall comply with the proposals if and so far as they consider it practicable to do so without prejudice to the efficient discharge of the general duties of the Board, or to the efficient execution of the scheme within the area, but subject to such conditions as the Board may think fit to impose."

Sir D. HOGG explained that the object of this amendment was to require the Board, under certain conditions, to delegate such powers and duties as could conveniently be dealt with locally by an association of owners of selected stations.

Mr. ATTLEE said any idea of compulsory delegation had been ruled out. Suggestions had been made for delegation to definite bodies set up, and the Government's reply was that it was much better to leave the Board unfettered. Now it was proposed to insert words proposing that an association of owners of generating stations might, if it satisfied certain conditions, apply for delegation, and then the Board should comply with these proposals for delegation, subject to certain conditions. Either these were effective instructions to the Board that they were to delegate, or they meant nothing, and were mischievous.

Sir D. HOGG said that the amendment merely indicated to the Board that if there was an association which was desirous of having powers delegated to it, the Board was favourably to consider the application.

The motion to agree with the Lords' amendment was carried.

On Clause 6 (New selected stations), Col. ASHLEY, the Minister of Transport, moved to agree with a Lords' amendment to Sub-section 1, stating:—"The Board may make arrangements with any authorised undertakers in whose area of supply, or in the neighbourhood of whose area of supply, any new generating station required by a scheme is to be situated, for the provision of such station, but where such area of supply is situate in an electricity district for which a joint electricity authority has been constituted, the Board shall first endeavour to enter into arrangements with the authority for the provision of such station." The Lords' amendment was to leave out all the words from the second "station." Col. Ashley said that it seemed to the Government that the Lords' amendment should be accepted, because otherwise, in the case of a new selected station the London agreement under the 1925 Act might be torn up and the settlement infringed. The House would recollect that under that agreement it was implied that the Commissioners should have full power to decide who should put up the new selected station or stations in the Metropolitan area. It was likely that the London J.E.A. would apply to put up a station at Chiswick, or on some other site, and if another station was wanted it seemed only fair that the other undertakers should have a chance of putting it up. It might well be that the needs of London for electricity might become so great that another station would have to be put up before the one at Chiswick was erected, and that should be left to the Board to decide.

Mr. KELLY, on behalf of the Labour Party, opposed the amendment, and said it was evidently the intention of the Government that private interests should be well protected.

Mr. ATTLEE also opposed the amendment, as did Mr. HARRIS for the Liberals.

Mr. R. S. HUDSON (Whitehaven, U.), the original author of the proviso, said that if there had been any difficulty as regarded London with any other undertaking entered into, that could have been met by keeping the Clause as it left the Commons and adding some small proviso excluding districts covered.

Eventually the motion to agree with the Lords' amendment was carried.

The SPEAKER ruled that the Lords' amendment to Clause 27 (Power to Treasury to guarantee loans to the Board), giving the Treasury the right to impose conditions, was a breach of privilege, and the Lords' amendment was disagreed with.

The first part of Clause 36 (Provisions as to companies with large areas of supply) reads as follows:—"Where after the commencement of this Act a special order is made authorising a company to supply electricity, and the area of the supply consists of or includes the whole of the districts of two or more local authorities, and is, in the opinion of the Electricity Commissioners, adequate in extent, the following provisions shall have effect with respect to the right of purchasing their undertaking." The Lords had passed an amendment to leave out the words from "supply" to "is." Col. ASHLEY moved to disagree with the Lords' amendment. The Government considered that on the whole it was far better to leave this finger post to the Commissioners, so that they might have an idea of what sort of area they should have to insist on in these proposed new companies. The amendment was disagreed to.

A number of amendments were agreed to in regard to the following new clause:—"Where any authorised undertakers may supply and are supplying within their district or area of supply electricity for haulage or traction to any company or authority being the owners or lessees of a railway, tramway, dock, harbour or canal undertaking situate partly within and partly without that district or area, such authorised undertakers may, subject to such limitations and conditions (if any) as the Minister of Transport may prescribe either generally or in any particular case, so supply electricity to be used for any purposes of such undertaking, whether within or without such district or area of supply, and such company or authority may, subject to such limitations and conditions (if any) as the Minister of Transport may prescribe either generally or in any particular case, use the electricity so supplied for any purposes of their undertaking for which they are entitled to use electricity:

"Provided that no such supply shall, without the consent of the Minister of Transport, be used by such company or authority for purposes of lighting, other than the lighting of vehicles or stations and other premises in the occupation of such company or authority."

The first of these was moved by Sir D. NEWTON (Cambridge, U.) to leave out "tramway." It was felt that under Section 5 of the Electric Lighting Act, 1909, there was already ample power to deal with any requirements of these undertakings.

Mr. R. S. HUDSON seconded the amendment.

Lt.-Col. MOORE-BRABAZON, Parliamentary Secretary to the Ministry of Transport, said that the Government proposed to accept the series of amendments, which were designed to safeguard and protect rather nervous local authorities. But he would feel bound to ask the House to accept the new clause as amended. No one who looked at electricity from a national point of view could afford to neglect the railway load, which was a very big and very convenient one. It had a load factor of nearly 40 per cent., and it showed a diversity factor which still further benefited the station load factor. Consequently, it was of the essence of the problem, when the railways required a supply of electricity, that it should come from the undertaking under the Board, and not be generated at a separate station belonging to the railways. At present, if the railways required electricity for other uses than haulage, they had to take it from the undertakers in the particular district where they wanted the supply. That had led to duplication of plant in many cases, and to unwarranted expense. It was really to stop any future agitation by a railway company to put up a generating station that he asked the House to accept the new clause. He was quite prepared to accept amendments so that the Minister's consent must be given and representations could be made. With that the Ministry thought that there would be no danger in future of the erection of separate generating stations, and the load of the railway companies would come to the undertakers of the country, which was only right.

Sir D. NEWTON's amendment was agreed to, as were the following further amendments to the Lords' amendment:—After the word "subject," insert "to the consent of the Minister of Transport and"; leave out the words "Minister of Transport" and insert "he"; after the word "subject" insert "to the consent of the Minister of Transport and"; leave out the words "the Minister of Transport" and insert "he"; and in line 18, leave out from the word "that" to the end of the Clause, and insert:—"The Minister of Transport shall not in any case give any such consent until notice of the application for the consent has been given by advertisement or otherwise in such manner as the Minister may direct, and an opportunity has been given to any person who appears to the Minister to be affected of making representations thereon."

The Lords' amendment, as amended, was then agreed to.

On the motion of Col. ASHLEY, the following Lords' amendment was disagreed with:—"Notwithstanding anything contained in any Act or Order, electricity supplied by any authorised undertaker to any company, body or person owning or working an undertaking being a port, dock or harbour may be used for all or any of the purposes of such undertaking or any part thereof." He explained that this new clause was really covered by the new clause just passed. Therefore, the only undertaking which the present amendment dealt with was the Port of London, and the Government regarded the amendment as a breach of the agreement arrived at under the Act of 1925, and that was why they disagreed with it.

The remaining Lords' amendments were agreed to.

When the Bill went back to the Lords on December 15th, there was considerable opposition to the Speaker's ruling that the amendment to Clause 27 was a breach of privilege, but eventually all the Commons' amendments to the Lords' amendments were agreed to, and the Bill received the Royal Assent, by Commission.

In his speech at the close of the Session, the KING said:—"By the passing of the Electricity (Supply) Bill an important and overdue step has been taken towards extending the provision of electrical energy throughout Great Britain."

Parliamentary News.

[By Our Special Parliamentary Reporter.]

Adjournment.—Parliament rose on December 15th, and will reassemble on February 8th.

Broadcasting.—On December 15th, in the House of Lords, during a debate on broadcasting, Lord LUCAN, on behalf of the Government, said that the growth of broadcasting was one of the great romances of scientific invention. By the end of November there were about 2,130,000 licences in force. Some measure of State, or even international, regulation was essential in order that the users of the wireless wave band should be mutually protected from overlapping and interfering with each other. The policy adopted in this country was to allow broadcasting in its infancy to be guided and developed by those having a direct interest in the successful development of the service. The men in control of the British Broadcasting Co. had exercised wide vision, and broadcasting had been set on a plane of high ideals.

Special Orders.—Special Orders have been approved authorising the London Electric Supply Corporation, Ltd., to supply electricity to be used for purposes incidental to the working or lighting of certain railways; relating to the urban district of North Walsham and parts of the rural districts of Aylsham, Blofield, Forehoe, Henstead, Loddon and Clavering, Mitford and Launditch, St. Faith's, Smallburgh and Wayland, Norfolk; the urban districts of Bakewell, Baslow and Bubnell, and South Darley, and part of the rural district of Bakewell, Derby; Horley and District (Extension); Midland Electric Power Distribution and Lighting (Extension); Wrexham (Extension); Porthcawl; Brynamman and District; and Chessington.

Gyroscopic Fog Device.—On December 15th, Mr. DAY asked the Secretary for Air if he would state the results of the tests of the gyroscopic fog-guide device, and whether any of those instruments had been ordered by the Ministry.

Sir S. HOARE said, on the assumption that the hon. member was referring to the Cooke-Schilovsky turn indicator, recently mentioned in the Press, the answer to the first part of the question was that the instrument had undergone satisfactory tests, and to the second part, that arrangements were being made to order a number for extended service trials and for training purposes.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Scrapping Old Plant: Would it Pay?

The electrical generating plant described in your issue of December 3rd by "Works Electrician" is, as he evidently realises, working inefficiently; for of 490 b.h.p. given by the engine (assuming a mechanical efficiency of about 88 per cent.) only 281.5 kilowatts, or 377 electrical horse-power, is being delivered at the terminals of the generators.

The mere substitution of a 300-kW generator for the three machines at present in use would not in itself effect a notable improvement, unless, of course, the present machines are of very faulty design. Although the modern d.c. machine is in many respects considerably better than the machine of 20 years ago, in point of efficiency it is not very much better than the product of that earlier date.

As the generators are at present working at partial loads, particularly Nos. 2 and 3, their combined efficiency will in consequence be rather low—somewhere around 90 per cent. possibly. If it were practicable to transfer the load of No. 3 to No. 2, and stop No. 3 altogether, the combined efficiency of the generators would by that procedure be improved by about 2 per cent. It should be noted that No. 2 would then be overloaded by about 5½ per cent., and before making the alteration it would be advisable to ascertain whether that machine would safely carry the overload. Otherwise it would be necessary either to transfer a portion of the load to No. 1, or else to arrange for Nos. 1 and 2 to work in parallel, so

as to permit of a more equitable distribution of the load. If, on stopping generator No. 3, some of the heavy shafting could also be cut out, then a more substantial improvement in efficiency would be effected, as the greater portion of the losses is probably in the shafting and belt drives, and not in the generators. In fact, provided the generators in question are in good condition, and are giving satisfactory service, the expense of installing a new large generator to take the whole of the load would hardly be justified so long as the present method of driving through the countershafting is retained.

If, however, it is possible to drive the proposed 300-kW generator direct from the engine fly-wheel or from a pulley on the engine shaft, thus substituting a single direct drive for the whole of the present wasteful belt and rope drives and eliminating altogether the length of heavy shafting already referred to, such an improvement could be obtained in the overall efficiency as might make the installation of the new generator worth while.

In the absence of fuller particulars, it is not possible to offer more definite advice, but we trust the above suggestions will be of service to your correspondent.

T. W. Broadbent, Ltd.

Huddersfield, *December 13th*, 1926. FRED. W. DAVIES.

The B.E.S.A. Glossary.

Professor Howe's letter in your issue of December 10th is no answer to my question. I did not suggest that either B or H had no objective existence. Neither did I mention magnetising force. I merely asked Professor Howe what was the *objective* difference between a field strength and a flux density. My inquiry applies to either the electric or the magnetic field.

C. L. Fortescue.

City and Guilds (Engineering) College,
London, *December 16th*, 1926.

British Water-power Resources.

What is the amount of potential and developed water power in the British Isles?

Is it not common knowledge that Loch Aber and the Grampians could give over 400,000 h.p., and that Ireland has 500,000 h.p.? These were published figures five years ago.

In the inaugural address by Dr. Eccles (*Journal*, I.E.E., December, 1926, p. 4), the British Isles are accredited with only 350,000 h.p., of which 80 per cent. (280,000 h.p.) is stated to have been developed. Where are these developed powers?

London, *December 15th*, 1926. **Theodore Stevens.**

London Traffic Co-ordination.

As a traveller on one of the routes investigated by the Advisory Committee on London Traffic, the account of its findings in your current issue has interested me not a little. That which impresses me most as calling for severe criticism is the utter bunkum talked about competition. Here we have notoriously inadequate and inefficient transport facilities, and those responsible for them have the face to say, in effect, that it is because there are too many facilities! What sort of competition, forsooth, has the London and North-Eastern Railway got to complain about while all its suburban trains during the rush hours are packed to suffocation, to such an extent that people (other than first-class ticket holders, who travel two in a compartment) arriving during the minute before a train leaves cannot even find standing room?

Competition in any business is of the very essence of efficient service to the public. Take it away as is suggested, place all services under one management, and the only incentive is gone; we have the equivalent of a spending Government department, and nobody bothers to improve. There is a glaring example of this in the grouping of the railways, only since which have we had, on this line at least, incessant lateness, disorganisation, and trivial breakdowns in the suburban services, with continually irritated passengers.

If the present road transport, with its lower fares and slower speed, succeeds in securing public patronage and results in thinning out the crowds using the railways, so much the better for those left travelling by train, and the railway companies must see to their own improvement first in order to regain the public. When they ask for protection against competition, it is really a business concern asking for protection against the effects of its own mismanagement. It is the kind of cry we should expect were their trains running half empty.

Snaresbrook, *December 15th*, 1926. **C. H. Clarke.**

Power Supply for Wireless Sets.

As Mr. P. K. Turner points out, I have assumed that the user of a h.p. accumulator is left to get it charged as best he can, and I think in the majority of cases this is so. If the listener does have his accumulator charged when necessary, whether at home or at a charging station, and he is prepared to give the accumulator all the attention it requires, the accumulator will do its job; but it is frequently out of sight, and the owner forgets either to take it to be charged or to switch on the charging apparatus until a day or two after the appointed time—but what does it matter?—everything is apparently working O.K. The next time it may be a week late, and so on.

I would remind Mr. Turner that my previous letter was only a contention that after taking into consideration outlay, cost of charging, depreciation of accumulator, and maintenance of charging apparatus (if any), the h.p. accumulator would not prove as cheap as the wet Leclanché cells for the *average* listener. I do not think the user of 15 mA, as mentioned by Mr. R. Kirlew, could be classed as an average listener.

As this is my first experience with wet Leclanché cells for h.p., I am afraid I cannot give Mr. Kirlew the information he requires. I should prefer to confine myself to the actual performance of the battery I am using.

In my set the anode current, with two valves working, is 2.3 mA; with four valves 3.8 mA. Approximately the battery has been working at 2.3 mA for 2,570 hours, and at 3.8 mA for 850 hours.

Should Mr. Kirlew require any further information concerning this battery, I shall be pleased to give him all I can.

No doubt, Sirs, you would pass my address on to him, should he so desire.

H. Hewlett.

London, *December 14th*, 1926.

Applying for Situations.

I have been for some time answering advertisements in the ELECTRICAL REVIEW, with the result that I have received answers and had interviews, but in not one single case has a promise been kept by the firms interviewed. Is it that they consider that politeness costs something, or that the present type of man selected to interview applicants is of a new breed which has lost all sense of the personal touch which should be offered to those applicants not so favourably placed as themselves? I have often left an office thinking to myself, well, at any rate, I shall know one way or the other within a few days whether my services will be accepted or not.

T. M. Johns, A.M.I.M.E.

Brighton, *December 14th*, 1926.

A Motor-Generator Snag.

Your correspondent who signs himself "Motor-Generator" does not give any particulars of the motor, while he states that at no amperes the generator gives 170 volts, and at 30 amperes it gives 100 volts; details of the motor and its type of field winding, if direct current, are essential before one can express an opinion.

It might be interesting to have information concerning the seat of the pain he mentions—does he have nerves in his pocket-book?

Theodore Stevens.

London, *December 13th*, 1926.

Regarding "Motor-Generator's" letter of December 10th, I venture to suggest that the motor-generator in question could have been used in conjunction with a variable resistance in the field operated by a shunted solenoid, or by some other device which would vary either with the load current or with the terminal voltage. The cost would not have been excessive, and one is given to understand that the motor-generator in question was rendered useless for "Motor-Generator's" purpose. The variation in voltage certainly seems excessive.

If the load on the generator was fairly constant, a hand-operated rheostat would have served in all probability.

December 13th, 1926. **Rheostat.**

Television.—In a recent issue of the ELECTRICAL REVIEW an account was published describing the work of Mr. J. L. Baird who, in January of this year, was successful in giving the first demonstrations of television. Those who were present at those first demonstrations will recollect that it was necessary for the person whose image was being transmitted to sit beneath a very brilliant light, the intensity of which caused considerable discomfort to the sitter. In the article it was pointed out that continual effort had been made to reduce this light, and that it had then been so reduced as to be no greater than the normal lighting of a photographer's studio. Whilst pursuing this line of research an effort was made to use the invisible rays at the end of the spectrum, that is, the infra-red rays. These rays, while possessing great penetrative power, have unfortunately a comparatively small photo-electric effect, and considerable difficulty was at first experienced on this account. This difficulty has now, it is claimed, been overcome, with the result that Mr. Baird has been able to demonstrate actual vision of an object which is in "total darkness." At a recent demonstration the sitter occupied a chair in a completely dark room before the transmitting Televisor. On the screen of the receiving Televisor in another room his *confrères* were able to see his features portrayed. It is noticeable, however, that the use of infra-red rays has a distinctly distorting effect on the reproduced image; red parts of the image tend to be reproduced as whites, while blue comes out as black. The very great penetrative powers of these rays, together with the fact that they are totally invisible to the eye, would indicate that a development of the present apparatus might provide an instrument of considerable utility in military and naval operations.

Reviews.

Tungsten: A Treatise on its Metallurgy, Properties and Applications. By COLIN J. SMITHELLS, M.C., D.Sc. Pp. viii+167; figs. 156. London: Chapman & Hall, Ltd., 1926. Price 21s. net.

The publication of a book on tungsten, bearing the name of so eminent an authority as Dr. Smithells, cannot but be regarded as a notable event in metallurgical literature. Few men have had the long and varied practical experience of tungsten technology which the author of this treatise has enjoyed, and the distinctive value of his work is that he has given us the full benefit of his practical and commercial study. It so frequently happens that those who are best qualified to inform others on metallurgical progress and are authorities on particular branches, are precluded by considerations of time and opportunity from rendering this service to their profession, that we can all be more grateful for the publication of the volume under review. Being a member of the research staff of the General Electric Company, the author has had a unique opportunity to gain practical experience in all problems relating to the manufacture of tungsten-filament lamps and thermionic valves, and as he modestly states in his preface, "the increasing importance of tungsten both to science and industry is offered as an excuse for the present volume, in which an attempt has been made to summarise the existing state of our knowledge of the subject."

In the preface Dr. Smithells states that 20 years ago tungsten was regarded as a rare metal, whilst to-day it is manufactured on a large scale in a state of purity scarcely equalled by any other commercial metal and is now the principal metal used for alloy purposes in connection with the manufacture of high-speed and cutting steels. The introduction to the volume reviews the history and development of tungsten and its ores, and gives tabulated data regarding the world production of the raw materials and the finished product. The subsequent chapters of the treatise deal respectively with the preparation, purification, and reduction of tungstic oxide, the manufacture of ductile tungsten, its metallography and properties, its industrial applications, and finally there is a well-written chapter on the determination of impurities in metallic tungsten. The volume contains valuable data on the special problems connected with the manufacture of tungsten wire suitable for the filaments of electric lamps. The industrial importance of tungsten is due to two outstanding and unique properties of the metal; its low vapour pressures at high temperatures, and its capacity of hardening metals with which it is alloyed. A high melting point does not necessarily render a metal suitable for the manufacture of electric lamp filaments, for the temperature at which a filament can be operated is determined by the rate of evaporation, which leads to blackening of the bulb and finally to failure. Probably carbon has a higher melting point than tungsten, but tungsten filaments, in vacuo, can be operated at from 1.2 to 1.7 watts per candle power, against 3.0 watts per candle power for a carbon filament having the same life. The properties which make tungsten a suitable material for lamp filaments are also desirable in the filaments of thermionic valves and tubes; the emission of electrons from hot tungsten has been exhaustively investigated by Richardson and Langmuir. The principal commercial application of tungsten is in the manufacture of steels and alloys for the production of high-speed tools, and magnets; among other technical applications, mention might be made of its use in the manufacture of X-ray targets, as a suspending medium for the moving coils of galvanometers and similar instruments, as a substitute for platinum contacts in magnetos, &c., and for the winding of refractory tube electric furnaces.

The section on the manufacture of ductile tungsten is excellent both in text and illustrations. A series of micrographs is given, illustrating the normal change in structure in a tungsten wire worked below the recrystallisation temperature, etched longitudinal sections of wires of different diameters being shown; the original equiaxed grains of the formed ingot are broken up and elongated in the direction of the wire axis, and are eventually only discernible as a bundle of fibres. It is this fibrous structure that gives tungsten wire its ductility. If the metal is heated above its recrystallisation temperature this structure is replaced by large equiaxed grains, and in this condition the wire is quite brittle. Tungsten is in this respect unlike the common metals, which become harder when cold worked, and softer and more ductile when recrystallisation is brought about by annealing. This brittleness of equiaxed tungsten, which is characteristic even of the purest metal, is difficult to account for, since single crystals of tungsten are extraordinarily ductile. The ductility of the fibrous material is no doubt due to the fact that it is practically a bundle of parallel crystals, each of which may be ductile. When the common metals are fractured at room temperature, the fracture takes place through the crystals, and not along the boundaries between them. Tungsten, however, gives an intercrystalline fracture at ordinary temperatures. An equiaxed wire breaks transversely, and the fracture follows the grain boundaries, whilst the fibrous wire tends to split longitudinally, by separation of the fibres, more particularly if the tungsten wire has been drawn or "swaged" at too low a temperature. The brittleness, therefore, appears to be due to lack of cohesion between the different grains. It appears highly improbable that this is a true property of the metal, since the cohesion between tungsten atoms, as determined by the tensile strength, is higher than that of almost any metal. The most likely explanation is that a film of foreign material, probably gas, exists between the grains even in the purest metal obtainable, and is the cause of weak intercrystalline cohesion. A parallel instance is seen in tantalum, which shows a similar brittleness unless it is first melted in a vacuum to remove absorbed gases. Whether or not tungsten prepared in a similar way would be ductile remains to be proved.

This treatise forms a very real addition to metallurgical literature, and the author is to be congratulated on its production. It can be recommended to all readers who desire to become conversant with the modern application of tungsten in hard-steel manufacture, and also that of lamp filament and thermionic valve, industries which are opening up a new sphere in our modern life and possess vast and still unexplored possibilities.

Alternating Currents. By C. E. MAGNUSSON, M.S., Ph.D., Professor of Electrical Engineering in the University of Washington. Pp. xvii+611; figs. 522. London: The McGraw-Hill Publishing Co., Ltd. Price 25s. net.

The volume under notice is the third edition of Professor Magnusson's work, and little alteration has been found necessary with regard to the main portion of the text, which deals with the basic principles of alternating-current engineering. Portions dealing with industrial applications have, however, been brought into line with the advances which have been made during the last decade.

The ground covered by the book can be divided roughly into three parts, the first dealing with current flow, power and power factor in single- and multi-phase circuits. This portion is followed by a lengthy section dealing with electrical machines used in connection with alternating-current circuits, and the book concludes with an account of problems encountered in the transmission of power by alternating currents.

Dealing with these sections in order, we note that a very characteristic feature of the book is the large use made of the method of complex quantities, the whole of the work dealing with the flow of current in single-phase circuits being founded on this method of treatment. Another feature worthy of note is that in connection with multi-phase circuits stress is laid on the fact that topographic vector diagrams may, in many cases, be usefully employed in addition to vector diagrams of the more usual type, and many problems are illustrated by diagrams of each kind.

The section dealing with electrical machines opens with an account of the transformer, and all the more common types of machines suitable for use on alternating-current circuits are discussed. There are, however, one or two surprising omissions; thus we do not find any account of phase advancers for use with induction motors, and the subjects of starting and speed regulation of the same type of machine are but lightly touched upon. We should also have expected to find an account of the self-starting type of synchronous motor which has recently attracted much attention in this country, and insufficient attention would seem to have been given to heating problems in electrical machines, particularly those concerned with intermittent loading. The small chapter dealing with the induction generator may be commended as being of particular interest.

In this section of the book a number of the vector diagrams are reproduced on too small a scale to be followed comfortably, this comment particularly referring to figs. 156 to 166 inclusive, comprising vector diagrams for transformers. On page 206 we note that figs. 243 and 244 have apparently become interchanged.

The portion of the book treating of transmission problems opens with an important and comprehensive chapter dealing with the properties of insulation and its behaviour under high electrostatic stresses, and both long and short transmission lines (especially the former) are very fully considered. A chapter on protective appliances is chiefly concerned with problems and appliances in connection with the protection of lines against excessive pressure rises due to internal or external causes, relays for use in connection with excessive currents due to shorts or earths being but lightly touched upon. No account is given of the many "balanced" systems which have been so highly developed in this country for "protection" against earths.

Many numerical examples are given at the ends of those chapters which lend themselves to the purpose, and the author rightly insists that the working of such examples is a most important part of the training of students, and recommends that the necessary data, whenever possible, be obtained from machines and circuits coming under the notice of the students concerned. There are a considerable number of half tone figures in the book; these are well selected and of much greater instructional value than is often times the case with such figures.

Readers will realise that such small criticisms as have been made are chiefly concerned with applications (always most difficult to treat of in an up-to-date manner in a text book) rather than with principles, and the treatment of the latter cannot be too highly commended, being suggestive and accurate throughout.

The work is worthy of inclusion in the libraries of all technical universities and technical colleges, and would form a good text book for students in the later years of their course. It may also be recommended to the notice of practising engineers who are particularly concerned with problems relating to transmission.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

The "Electrical Review" Index.—The Index to Vol. XCIX (for the half-year ending December 31st, 1926) is now in preparation, and we shall be glad to receive the names and addresses of those who require it (free of charge) for binding purposes, or wish to retain it for reference. Application should be made as early as possible to the Publisher, 4, Ludgate Hill, E.C.

The E.D.A.-E.L.M.A. Campaign.—The official report for the week ended December 18th is as follows:—Three new circles were formed at Falkirk, Dovercourt and Harwich, and Leamington, making the total 102. Two demonstration houses were opened at Nottingham, and the following towns are opening houses shortly:—Bishop Auckland, Walsall (2), Whitley Bay, Whickham, Blyth, South Shields, and Denton. Glasgow has an ambitious programme, comprising a 5-apartment house, two tenement houses, and a large 7-roomed house. Paisley intends to open another, larger, house in the New Year. About 3,500 persons have visited the Low Fell house organised by the Newcastle circle, and the attendance at the Nottingham houses has averaged 230 per day, and excellent results are reported. The Shropshire, Worcestershire, and Staffordshire Electric Power Co. opened an exhibition at Dudley on December 14th, and other exhibitions are being organised at Leamington, Greenock, and Falkirk. The Tamworth Supply Co. has organised a local competition in addition to the national one, and competitions have also been arranged at South Shields and in the North-East Coast area. Many districts report that the prize-house poster and special kinema slides are being used with success, and nearly all centres record an increased demand for the competition booklet, presumably as a result of the Press advertisements. The E.D.A. is contemplating the issuing of a small cardboard model of the prize house. This will be in the form of a flat sheet in four colours which can be cut up and put together. Supply authorities and contractors are asked to write for supplies of these; in the case of orders for fair quantities, arrangements for overprinting will be made.

In our weekly references to the Campaign it has not been possible until now to say much regarding the progress that was being made in the London and Home Counties area. It may have appeared that we were placing undue emphasis upon what was taking place in certain other parts of the country, and that London was not receiving its share of attention at our hands. The explanation has to be sought in the well-recognised fact that there is only one London, and that we who are in it most of our time do not find it easy to see signs of any intensive campaign activity. When we refer to London we have to remember that London itself, with its enormous population, is only one part of the big London and Home Counties Area. There may be much doing that neither meets the eye nor reaches the ear, but if London authorities and contractors each lit their torch of effort what a blaze the area would be—we should both hear things and see things too. We are half through the period of the Campaign, and if the London and Home Counties Area is not going to be beaten by provincial centres it will have to get a move on directly after Christmas. We have now received a brief report of a meeting of the Supply Engineers in the Area which was held at the E.L.M.A. Lighting Service Bureau on Friday, December 10th, and from this it is possible to show more clearly than hitherto just what is happening. Some 40 gentlemen were present, and in the absence of Mr. A. F. Harrison (chairman of the Area Committee), at the commencement of the proceedings, Mr. R. W. L. Phillips presided. Mr. Beauchamp explained that the object of the Committee in calling the meeting was to stimulate greater activity in the Area, and Mr. Dale followed with a progress report both for the Area and in the country generally. Electrical circles have been set up in 22 places in the London and Home Counties Area as follows:—Weymouth, Hackney, Hendon, Bedford, Basingstoke, Epsom, Twickenham, Hampstead, Folkestone, Stepney, Woolwich, Gravesend, Ashford, Great Yarmouth, Felixstowe, Brighton, Portsmouth, Aylesbury, Richmond, Surbiton, Ipswich, and Leatherhead. Demonstration houses and exhibitions are already opened at Potters Bar and Ashford, and they are in prospect at Brockley, Tottenham, Basingstoke, Lewes, Portsmouth, and Great Yarmouth. Mr. Bush stated that in spite of the large number of circles set up in the area, the activities of the circles were not progressing as rapidly as was the case in many of the provincial districts. The discussion which followed showed that intense campaign activity was taking place in certain parts of the area, whilst in others activity was being hampered owing to the alleged difficulty of co-operation. The chairman of the committee assured the meeting that, in his personal experience in a large London company, this difficulty had been completely solved to the mutual advantage of the supply undertaking and the contractors. Several engineers testified to the immense value of the electrical circles which had been set up, and expressed the hope that, after the campaign ceased, the Circles would be kept going. At the close of the discussion the following resolution, proposed by the chairman and seconded by Mr. Cramb, was carried unanimously:—

"That all supply engineers in the London and Home Counties Area who have no W.O.B. circles be asked forthwith to convene or form such a circle or circles in their own area. In places where local conditions make co-operative circles quite impossible, supply engineers be asked to push the campaign with their own staffs and so far as possible to operate themselves all those campaign activities being carried out by circles."

As we have already reported, two demonstration houses have been opened at Nottingham, one in the southern area of the city and the other at West Bridgford, the chief residential suburb. Ald. E. Huntsman, chairman of the City Electricity Committee, formally opened the Nottingham house; Mr. W. J. Furse, chairman of the Urban District Council, fulfilling a similar task at Bridgford. Ald. Huntsman observed that whilst people in this country had long been accustomed to the value of electricity for purposes of industrial power and lighting, the uses of electricity in the home had been sadly neglected. He thought that this was largely the fault of those who were themselves concerned in the electrical industry, for they had not availed themselves to the full of the advantages of publicity. Mr. H. Talbot, chairman of the Nottingham District Committee, presided at the Nottingham installation. Arrangements have been made for the houses to remain open until January 5th.

The Birmingham Committee is continuing its activities, which have resulted in the arousing of interest in large numbers of people. The demonstration houses are being well attended, and have been rendered particularly striking at night by the employment of flood lighting.

The British Industries Fair.—The Birmingham Executive of the British Industries Fair reports that wholesale and retail organisations in practically every section have decided to send representative delegations to the February Fair. It was only at the 1926 Fair that the first structural extensions in Birmingham gave facilities on any scale, for the hospitable reception of trade delegations. The informal conferences of exhibitors and buyers proved of such value to the mutual interests of producing and selling that arrangements have already been made for the reception next February of 47 trade delegations—an average of about seven a day during the period allotted. The civic delegations to the Birmingham Fair, headed by the chiefs of the leading industrial municipalities, assume greater importance each year. Last February more than 50 official representatives of city and town councils were received on one day; for the 1927 Fair the Lord Mayor of Birmingham (Ald. A. H. James, C.B.E., J.P.) has just issued personal invitations to the lord mayors, lord provosts, mayors, provosts, and principal officials of no fewer than 250 boroughs.

The German Low-Pressure Industry.—Negotiations have been proceeding between a number of low-pressure concerns in Germany with a view to bringing about an amalgamation, but it is stated that the situation is such that a speedy result is not expected. Efforts to secure a fusion solely between the Telephone Company (late Berliner) and the Telephone and Telegraph (Fuld) Company, of Frankfort-on-Main, are said to be more promising. In the case of the other companies, it is said that the formation of a combine is meeting with considerable difficulties both of a material and personal kind.

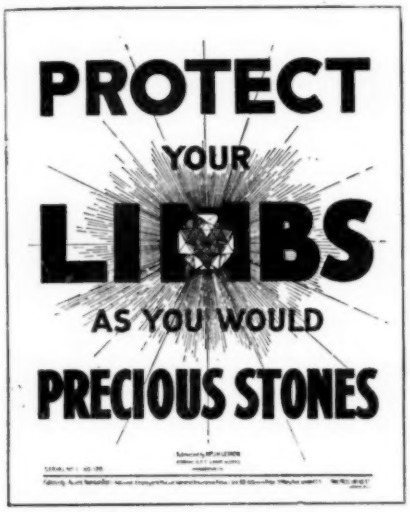
Dutch Loan for German Works.—The Amsterdam correspondent of the *Financial Times* reported last week that an issue was being made in that city of $2,000,000 6½ per cent. bonds of the Berlin Electricity Works at 98.25 per cent. The issue formed part of a total of $20,000,000.

Electricity Supply Offers for Luxemburg.—Two tenders have been received by the Government of Luxemburg for the establishment of an electricity supply in the Grand Duchy. The first emanates from a combination of four Luxemburg iron companies and three Lorraine electricity supply concerns, as well as the Centrales Electriques des Flandres. This scheme provides for the establishment of a supply in the first instance in the thickly-populated industrial district of the south, which would be undertaken by the Centrales Electriques or a company to be formed by this undertaking, and afterwards by the provision of a supply in the north with the participation of the State of Luxemburg. The second offer has been presented by the Compagnie Industrielle et Commerciale, Brussels, which proposes the formation of a Luxemburg national company, for the supply of the whole of the Grand Duchy, with a share capital of 20,000,000 gold francs, of which 70 per cent. would be provided by American and English financiers, and 30 per cent. by the Luxemburg Government. In addition, a loan of £1,300,000 would be raised. This scheme would have as its basis, it is said, the establishment of a great cokery with a national generating station, while in the case of the first project part of the energy would be obtained from outside the Grand Duchy.

Spanish Telephone Development.—The Standard Telegraph Co., the new title of the amalgamated Spanish concerns—the Telefonos Bell and the Western Telegraph Co.—is establishing a factory near Santander for the manufacture of telephone cables and wires. Works for the manufacture of telephone apparatus and accessories are also being established in Madrid.

Conditions in Sweden.—The *Swedish Economic Review* (the official organ of the Swedish Board of Trade) for the July-September quarter says that the ore-mining and metal industries were affected in certain respects by the English coal dispute, but conditions in the actual iron industry improved somewhat. The most favourable position in the engineering group was occupied by the electro-mechanical industry, which was unable to find sufficient skilled labour consequent upon the rapid revival after the period of depression. The exports of electrical machines for the first nine months of the year were valued at 19,246,000 kr., as compared with 14,247,000 kr. during the corresponding period of 1925. The value of exported telephone and telegraph apparatus for the same period was 5,016,000 kr., as compared with 4,987,000 kr.

Accident Prevention.—An electrical man secured the November poster award of the National Employers' Mutual General Insurance Association's Accident Prevention Department. He is Mr. J. H. Lemon, of the Osram-G.E.C. Lamp Works, Hammersmith, and his adopted suggestion is reproduced herewith. The poster measures 24 in. by 20 in., and is effectively printed in red and black. The Association has sent us an interesting booklet on "Accident Prevention for the Employer," which contains many useful suggestions.



A "Safety First" Poster.

The booklet is one of several published by the Association, which also supplies first-aid cabinets made up in accordance with statutory requirements.

Unemployment.—The Employment Exchange registers for December 6th showed a total of 1,506,300 unemployed. This was a rise of 10,233 during the week, and was 345,043 more than at December 7th, 1925.

Australian Power Station Strike.—A *Reuter* message from Melbourne, dated December 16th, said that a number of works would be compelled to close on Monday (December 20th), and thousands of workers would be rendered idle when power and electricity rationing was to be enforced owing to the strike of workers at the Yallourn power station, which had been proceeding for over a fortnight. The restrictions were only to be enforced on alternate days, but many establishments were closing down altogether for the period of the strike. A later message stated that the strike had been settled and work was to be resumed on December 20th.

Catalogues Wanted at Buenos Aires.—The Technical Office of the City of Buenos Aires Beneficent Society, which builds and equips hospitals, homes, asylums, &c., for the Charity Society, is advertising in *The Times* inviting firms supplying materials and equipment to forward priced catalogues and illustrations. The Department (address 269, Reconquista, Buenos Aires) installs electromedical apparatus, apparatus for radio-therapy, and so forth.

Garden City Schemes.—The December issue of *Garden Cities and Town Planning* is devoted entirely to an account of Welwyn Garden City. One of the articles (by Mr. F. H. Masters) deals with the subject of garden cities and electricity supply, and shows that the successful establishment of a garden city depends on electricity supply being available, and that electrical consumption in garden cities should be high. Such schemes should therefore be encouraged. What has been done at Welwyn is used to illustrate both the foregoing points.

The Chemical Industry Merger.—We have received copies of circulars which have been sent to the shareholders of Brunner, Mond & Co., Ltd., Nobel Industries, Ltd., the United Alkali Co., Ltd., and the British Dyestuffs Corporation, Ltd., the companies which are merging their interests on January 1st to form Imperial Chemical Industries, Ltd. These point out the benefits which will result from the amalgamation, and the shareholders of the four companies are advised to exchange their holdings for the new company's shares. The authorised capital of the new concern is £65,000,000, and the issued capital, assuming that all the shareholders of the participating companies exchange their holdings, will be £56,802,996.

Unsatisfactory German Equipment in Brazil.—*Commerce Reports* says that several reports have been received from Brazil relative to the unsatisfactory results obtained from installed German electrical apparatus. Cheap equipment of German manufacture has caused much dissatisfaction among electricity consumers in that country, due to the inefficient operation and excessive costs of upkeep.

Social Events.—On December 10th, the staff of the Leeds Branch of the Siemens & English Electric Co., Ltd., held their annual social, consisting of a whist drive, supper and dance. Mr. J. Green acted as M.C. for the whist, and Mr. F. H. Webb conducted the dance. Music was provided by the "Seelco" dance orchestra—Messrs. Johnson and Johnston and Miss I. Lambert. The prizes, given by friends of the company, were presented by Mrs. Green.

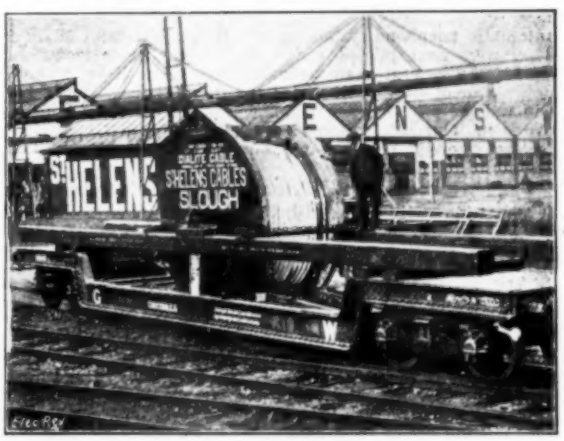
On December 17th the staff and employés of Messrs. H. W. Sullivan, Ltd., held their annual dinner at the Restaurant Frascati. Mr. D. A. Stevens, B.Sc., presided, in the absence of the chairman, Lt.-Commander W. G. Bishop, O.B.E., and sent a wire to the latter conveying the company's regret at his indisposition. After the loyal toast, Mr. Stevens proposed the toast of "The Staff and Employés," and made reference to the progress which the company had maintained during the past year. He mentioned the heating department, which had secured a very good share of orders during an exceptional period. Mr. W. H. F. Griffiths responded on behalf of the staff, and expressed their confidence in the directors, and Mr. A. Richardson spoke for the other employés. Mr. J. H. Stephens (director) proposed the toast of the Press, and Mr. H. F. R. Grantham gave the health of "The Chairman and Directors," to which Mr. Stevens responded. Interspersed with the toasts was an excellent concert, to which members of the company contributed.

Hydro-Electric Plant for Ecuador.—*Commerce Reports* says that the Municipal Council of Quito, Ecuador, intends to invite bids shortly for the erection of a 3,000-h.p. hydro-electric plant to be owned and operated by the city.

British and American Radio Exports.—An interesting comparison of radio exports from the United Kingdom and the United States during 1925 appeared in a recent issue of *Commerce Reports*. It is shown that the United States exported such goods to the value of $9,903,857, while the value of United Kingdom exports was $6,496,532. In the European market the United Kingdom predominated, its exports, valued at $2,681,339, being three times those of the United States. Only to three European countries (Hungary, Latvia and Spain) did the United States export more radio apparatus than this country. In Australia and Africa, also, British exports were taken to a greater extent. America practically monopolised the Canadian market, having supplied goods valued at $3,703,133 as against $257,747 for the United Kingdom. The same was the case to a smaller degree in the Asiatic and Latin-American markets.

The cross-trade figures are of interest: the United Kingdom supplied apparatus valued at $261,509 to the United States, and received from the latter goods to the value of $644,916.

A Heavy Bitumen Cable.—The accompanying illustration shows a drum of cable about to leave the Slough works of the St. Helens Cable & Rubber Co., Ltd. The drum bears 770 yards of 0.1 sq. in., 3-core, e.h.p. "Dialite" bitumen cable



A Heavy Bitumen Cable.

with an overall diameter of 4 in. The total weight of the whole is 15 tons, of which the drum accounts for two tons. The company says that it believes the cable to be the heaviest drum load of this type ever made.

French "Luxury" Taxes.—The December *Bulletin* of the British Chamber of Commerce in Paris contains a full list of articles subject to the "luxury" tax under regulations put into force during November. The list includes certain classes of decorative lighting apparatus sold at above specified prices, and also radio apparatus, as follows:—"Receiving posts, not fitted," where the price exceeds 700 fr.; loud speakers, 200 fr.; and accessories and detached parts, 70 fr. per article.

An Insulating Ash Tray.—We have received from the SILUMINITE INSULATOR CO., LTD., an ash tray moulded in one of the various grades of insulating materials manufactured by the company.

Price Reductions.—The B.E.N. PATENTS, LTD., announce reductions in the prices of their electric drills as from January 1st, 1927, owing to increased production and anticipated trade revival.

Lead.—Messrs. James Forster & Co. report under date December 18th:—"Viewing the position as a whole, we are inclined to the opinion that the market is gradually getting on to a sounder basis, and that consumers would be well advised to cover their forward requirements at the present level of prices." The Board of Trade returns for November, 1926, are:—Imports, 18,192 tons; exports, 1,377 tons; left for home consumption, 16,815 tons.

Henley's Dramatic Club.—On Friday evening last, at the Cripplegate Theatre members of Henley's Dramatic Club gave a performance of "The Passing of the Third Floor Back" before the usual large and appreciative audience, which consisted mainly of members of the London staff of W. T. Henley's Company. Of the play itself little need be said—it has so often proved its popularity; yet we must pay Jerome just tribute by remarking that we shall all be the better for trying to see the good, and the possibilities for good, that lie slumbering or hidden in our everyday associates. In any concern the preparation and performance of such a piece could hardly fail to soften the asperities of business life. We offer our congratulations to Mr. Henry Thornton, the producer, who played the principal part ("The Third Floor Back"), and, indeed, to all the performers.

A Visit to the A.T.M. Works.—On December 11th, approximately 70 members of the North-Western Centre of the Sanitary Inspectors' Association visited the Strowger and Broad Green Works of the Automatic Telephone Manufacturing Company, Ltd. The visitors first inspected the manufacture of "Xcel" domestic appliances, including cookers for several leading electricity supply authorities at home and abroad. Proceeding thence to the main Strowger Works, Edge Lane, the guests were given a talk on the A.T.M. (Strowger)

Assembling "Xcel" Domestic Appliances.

automatic telephone system by Mr. H. H. Harrison, M.I.E.E. They were next piloted round the various departments and shown the several manufacturing processes involved in the production of equipment under construction for Greater London and the provinces, as well as for telephone administrations overseas. Our illustration shows a part of the Broad Green factory where "Xcel" irons and other appliances are being assembled.

Catalogues Without Prices.—*British Industries* (the official organ of the F.B.I.) recently published a complaint from a railway manager in South America that many British catalogues received by him do not contain prices. A member firm of the F.B.I. says that this complaint does not apply to the British machine tool industry, as the catalogues of American and German makers do not give any more particulars than do the British. The firm states that up to the outbreak of war it always issued catalogues completely priced, but it has only just become possible to revert to this policy, and even now the price list is issued as a separate document with a proviso that the quotations are liable to fluctuation. Our contemporary says that there has been very good reason for omitting prices from catalogues since the end of the war, but at the same time a hint of this kind coming from a well-wisher, who is also an important consumer, seems to be worth passing on to those whom it is intended to benefit.

Australian Electrical Exhibition.—In conjunction with the electricity supply authorities, the Electrical Federation (Victoria) is organising an all-electrical exhibition to be held in Melbourne from September 10th to October 1st, 1927. The exhibition will include both locally-produced and imported appliances, and will cover all phases, including engineering, domestic appliances, accessories, and radio work.—*Reuter's Trade Service* (Melbourne).

New French Company.—A company has been formed at 7, Rue Falguiere, Paris, with a capital of 400,000 fr. and the title La Société La Lampe Stella, to acquire and carry on the electric lamp business of Audoux & Co.

Calendars and Diaries.—A neat wall calendar has been received from the HART ACCUMULATOR CO., LTD. A set of monthly slips is mounted beneath one of the company's well-known pictures—that depicting a number of popular operatic characters.

The 1927 calendar issued by MESSRS. C. A. PARSONS & CO., LTD., is historical, and traces the progress of steam from the Whirling Aeolipile of Hero of Alexandria to the rather more efficient machines made by the company for the Dalmarnock and Barking stations. The illustrations are reproductions of old engravings from various sources.

The Birmingham Branch of the E.G.S. CO., LTD., has chosen an armed tea clipper with all sails set as the subject of its 1927 calendar. Below the picture are monthly date slips.

MESSRS. S. G. BROWN, LTD., have issued a simple single-card wall calendar depicting a pretty child wearing a pair of the company's headphones. In the four corners are pictures of typical "Brown" radio apparatus.

MR. E. H. APPLEBY, radio and electrical engineer, of The Croft, Willesden, has issued a coloured pictorial wall calendar for 1927.

A parrot in natural colours perched upon an oval frame below which is a set of monthly date slips, has been received from the DOUGLAS ELECTRIC LIGHTING & POWER CO., Douglas Street, E.14.

The calendar of the BRITISH BROWN-BOVERI, LTD., London, consists of 12 monthly sheets, most of which bear excellent views of Swiss railways.

MESSRS. J. SHAW, SON & GREENHALGH, LTD., of Huddersfield, have prepared a calendar with a block of plainly figured daily date slips for 1927.

From MR. W. H. SQUIRE, of 31, Sweyne Avenue, Southend-on-Sea, there has come to hand a wall calendar with coloured river and mountain view—"The Land of his Fathers."

From the LIVERPOOL ELECTRIC CABLE CO., LTD., Linacre Lane, Bootle, Liverpool, we have received a handy-sized wall calendar with monthly slips.

MR. CHARLES SELZ, of 47-49, New Cavendish Street, London, W.1, has prepared a vest-pocket diary and season ticket holder.

"The First Breath of Spring" (violets and primroses), is the title of the picture adorning the calendar of MESSRS. G. NOBBS, LTD., of 89, Cleveland Street, Euston Road, London, W.1.

From MESSRS. ARTHURS, 110, Charing Cross Road, London, W.C.2, we have received a wall calendar, each sheet of which bears two months' dates and a humorous picture in colour.

A wall calendar with a block of daily slips has been received from Messrs. CAPPER, PASS & SON, LTD., Bedminster, Bristol.

Catalogues and Lists.—THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—A well-illustrated descriptive catalogue (B.C.1) of "Gecophone" radio receiving sets, amplifiers, components, and accessories. Priced.

MESSRS. CROSSLEY BROS., LTD., Openshaw, Manchester.—A booklet containing a number of users' opinions of Crossley petrol-paraffin engines.

THE STURTEVANT ENGINEERING CO., LTD., 147, Queen Victoria Street, E.C.4.—Publication No. 1,220, a beautifully-illustrated brochure dealing with the company's vacuum-cleaning equipment and depicting a number of important installations.

THE BENJAMIN ELECTRIC, LTD., Brantwood Works, Tottenham, N.17.—Christmas number of the "The Benjamin Reflector" suggesting suitable presents in the form of automobile accessories, portable lamps, radio apparatus, &c.

THE STONEBRIDGE ELECTRICAL CO., LTD., Victoria Road, North Acton, W.3.—Leaflet No. 81/1, illustrating and describing the company's recording instruments, particularly power-factor meters.

THE SUN ELECTRICAL CO., LTD., 118-120 Charing Cross Road, W.C.2.—A handsomely-bound catalogue (472 pp.), profusely illustrated, containing particulars and prices of all kinds of electrical supplies, including motors, switchgear, wiring materials, signs, domestic appliances, &c. Radio apparatus and domestic lighting fittings are dealt with in separate catalogues issued by the company.

MESSRS. MATHER & PLATT, LTD., Park Works, Manchester.—A brochure, entitled "Electric Power in the Paper Industry" containing numerous pictures of actual installations by the company of plant in paper mills.

ARUNDELL DISPLAY, LTD., 40, Shaftesbury Avenue, London, W.C.1.—Pamphlet relating to the services that the company offers in connection with window displays.

MESSRS. J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall.—Leaflet No. 1,024, containing illustrated particulars and prices of interlocked switch sockets with moulded insulation and metal cases.

MESSRS. HOUGHTON-BUTCHER (GREAT BRITAIN), LTD., 88-89 High Holborn, W.C.1.—"Houghtons Radio News" for December, containing information regarding radio apparatus of all makes, with "sales suggestions" and other useful notes.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester.—An illustrated description of an installation of "Chloride" batteries on a Stratford-on-Avon farm.

MESSRS. DANIEL ADAMSON & CO., LTD., Dukinfield, Manchester.—A pamphlet dealing with the company's drainage system.

Trade Announcements.—On and after January 1st the address of WELDRICS (1922), LTD., will be Station Road, Beeston, Notts. Telephone: Beeston 245; telegrams: "Weldrines, Beeston, Notts." New plant is being installed at these premises.

FULLER'S UNITED ELECTRIC WORKS, LTD.—Sir John Mann, the receiver and manager of this company, has issued a circular, dated December 14th, stating that, having disposed of the accumulator department and the cable and wire department of the business, he is no longer responsible for any goods ordered for these departments. The respective purchasers are: The Accumulator Department—Fuller Accumulator Co. (1926), Ltd.; the Cable Department—The Metropolitan Electric Cable and Construction Co., Ltd. The ebonite department and the carbon black department of the company's business are still for sale, and are being carried on by him as receiver. He remains responsible for any goods ordered by his authority for these departments.

THE METROPOLITAN ELECTRIC CABLE & CONSTRUCTION CO., LTD., in announcing its acquisition of the wire and cable section as a going concern, states that the lay-out of the factory has been altered and modernised to secure improvement both in quality and output. Various additions and extensions are in hand. The works are at present manufacturing the following types of cable: All sizes of v.i.r. taped and braided cables, lead-covered cables, armoured cables, mining cables, c.t.s. cables, motor-car cables, and aerial cables. Particulars of the registration of the Metropolitan Co. appeared on page 1005 of our last issue. Mr. D. D. Warren is chairman of the company, and Mr. W. Brown is managing director.

The address of the Electricity Department of the County Borough of Stockport has been changed. Communications should be addressed to:—The Borough Electrical Engineer, Electricity Offices, 23, Tiviot Dale, Stockport. Telephone: Stockport 620.

MESSRS. CHARLESWORTH PEEBLES & CO. announce that their telephone numbers are now: "Museum 6575 and 6576."

ELECTROLUX, LTD., has opened a modern showroom in Northgate, Blackburn, where it has a large collection of electrical apparatus.

The ELECTRICITY DISTRIBUTION OF NORTH WALES & DISTRICT, LTD., has opened a wiring and installation department at 31a, High Street, Sandbach, in connection with the pending supply of electricity to Alsager, Elworth, Sandbach, and Haslington.

Mr. J. H. CHARLESWORTH, for 25 years with Messrs. Carrington & Button and their predecessors, has commenced business as an electrical and radio engineer at 12, West Street, Crewe, in partnership with Mr. G. S. Whiston.

Bankruptcy Proceedings.—C. W. WATSON, 33, Rainhall Road, Barnoldswick, Yorks., electrical and wireless engineer.—The first meeting of creditors was held on December 8th, at the Official Receiver's Office, Bradford. The statement of affairs showed ranking liabilities of £834, and there was a deficiency of £775. Debtor attributed his failure to lack of capital, falling values of stock, bad trade and heavy court and execution costs. The case, being a summary one, was left with the Official Receiver as trustee.

A. J. MCMAHON, 29, Park Mead Road, Wyke Regis, 51, St. Thomas Street Weymouth, and Melcombe Regis, Dorset, general store dealer and electrical contractor.—The public examination of this debtor was held recently at the County Hall, Dorchester. The statement of affairs showed liabilities of £704 and net assets of £481, leaving a deficiency of £223. Debtor attributed his failure to insufficient capital, outlay on grocery business at Wyke, and pressure by creditors. It appeared that he commenced business as an electrical engineer in July, 1922, with £500 capital, his own money, in partnership with another, who provided no cash. In December, 1923, the partnership was dissolved, debtor taking over the liabilites. In September, 1926, debtor also began to trade as a grocer and general store keeper, and had apparently since carried on the two businesses. Early in November a meeting of the creditors was called, but was cancelled as a result of his filing his petition. Five creditors had obtained judgments and levied executions. After further questions the examination was closed.

R. FENTON, 74, Park Road, Chesterfield, Derbyshire, late 514, Sheffield Road, Chesterfield, electrical engineer.—The public examination of this debtor was held on December 10th, at the County Court, Chesterfield. According to the statement of affairs, there was a deficiency of £316. Debtor attributed his failure to loss on contracts, lack of capital, and costs of judgments and sheriff's charges. The examination was closed.

H. E. PARRIS (trading as the St. George's Electrical Manufacturing Co.), 154, Upper Thames Street, E.C., and formerly 20, High Street, Sydenham. An application was made on December 14th to Mr. Registrar Mellor, at the London Bankruptcy Court, for an order of discharge on behalf of this bankrupt, who failed in 1905. The Official Receiver reported that the provable debts amounted to £215, and the estate had realised less than £2. The discharge was granted subject to a suspension of one month.

A. J. WELLS, 16, Malvern Road, Luton, lately trading with another as Wells & Co., 52, Princess Street, Luton, electrical engineer.—The public examination of this debtor was held on December 16th at the Court House, Luton. The statement of affairs showed ranking liabilities of £77, while in addition there were contingent liabilities of £274. The deficiency amounted to £60. Debtor attributed his failure to bad trade.

T. BARTON, The Electric Works, Ainsworth Street, Blackburn, electrical engineer.—The trustee, Mr. A. T. Eaves, 47, Mosley Street, Manchester, has issued a statement showing that a dividend of 15s. in the £ has been paid on admitted claims totalling £4,439. He intends to apply for his release, and objections should be sent to the Board of Trade by January 5th.

H. H. ATKINSON, electrical engineer, 33, Princes Avenue, Old Trafford, Manchester.—Application for discharge to be heard January 11th, at the Court House Salford.

N. H. PAYNE, electrical and wireless engineer, 4, The Triangle, Teignmouth, and late of Dawlish.—First meeting held December 23rd, at the Official Receiver's offices, Exeter Bank Chambers, 67, High Street, Exeter. Public examination, January 13th, at the Castle, Exeter.

B. G. THOMPKINS, radio engineer, Armstrong Buildings, Stanley, Durham.—First and final dividend of 3s. in the £, payable at the Official Receiver's office, 81, St. Mary's Place, Newcastle-on-Tyne.

D. T. DONOVAN and H. A. LANGLOIS (The London Electrical Co.), electrical engineers, 119, St. Mary Street, and 124, Queen Street, Cardiff.—Receiving order made December 13th on debtor's own petition.

G. F. WOOD, electrical engineer, 28, Highgate Road, N.—Trustee, Mr. D. Williams, Official Receiver, Carey Street, W.C., released December 10th.

G. W. RIDLEY, electrical engineer and contractor, 1, Alfred's Court, Chorley, Lancs.—Trustee, Mr. H. Parker, Official Receiver, 11, Winckley Square, Preston, released December 9th.

J. R. PEET, electrical engineer, Earsdon, Linden Walk, Prestatyn, Flint.—Receiving order made December 8th, on debtor's own petition.

H. BEBBINGTON, electrical engineer, 14, Cestrian Street, Bolton.—First meeting held December 22nd, at the Official Receiver's offices, Byrom Street, Manchester.—Public examination January 18th, at the Court House, Bolton.

Company Liquidations.—SOLIDITE MANUFACTURING CO., LTD.—Winding up voluntarily. Liquidator, Mr. L. R. Shaw, 4, Broad Street Place, E.C. The liquidator is authorised to sell to Mr. J. A. Swain the goodwill, undertaking and the assets, &c., of the company and to consent to the registration of a new company, to be called the Solidite Moulding Co., Ltd., or some other suitable name. A meeting of creditors is called for December 29th, at the offices of the liquidator. This notice is formal, all known creditors have been paid in full.

ALPHA ELECTRIC & OXY-ACETYLENE WELDING CO., LTD.—Winding up voluntarily. Liquidator, Mr. F. Reed, Westgate Chambers, Newport.

E.I.C. MAGNETOS, LTD.—Winding up voluntarily. Liquidator, Mr. A. V. Jerome 15, Newhall Street, Birmingham. A meeting of creditors was held at the liquidator's offices on December 21st.

SWIFT ELECTRICAL, LTD.—Liquidator, Mr. H. E. Burgess, Senior Official Receiver, Carey Street, released November 19th.

Dissolutions of Partnership.—LEE & BUFTON, electrical engineers Fornham Street, Sheffield.—Mr. H. Bufton and Mr. W. Marples have dissolved partnership. Mr. Marples will attend to debts and continue the business under the same style at the old address.

PARADE MOTOR CYCLE AND ELECTRICAL WORKS, 21B, Marina, St. Leonards-on-Sea.—Mr. J. Hughes and Mr. A. C. Hughes have dissolved partnership. Mr. J. Hughes will attend to debts and continue the business.

WILEMAN & Co., electrical engineers and contractors, 3, Station Road, Maesteg.—Mr. N. A. Wileman and Mr. W. G. F. Chappell have dissolved partnership. Mr. Wileman will attend to debts.

Deed of Assignment.—W. L. GRAY, electrical and wireless engineer, 9, Victoria Parade, Muswell Hill, N.—Particulars of claims by January 3rd, to the trustee, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C.

New Municipal Showroom.—The Ilford Electricity Committee is to obtain a site at Gants Hill Cross for an electricity showroom.

Local Exhibition.—PADIHAM.—At the Padiham Technical School, an electrical cooking and domestic appliances exhibition was opened last week by Councillor J. W. Coe, J.P., who said Padiham had now similar advantages to other towns in electrical power and lighting. The exhibition contains numerous appliances by various electrical firms.

For Sale.—The Doncaster Corporation is inviting tenders for the purchase of one 1,250-kVA turbo-alternator. (See our advertisement pages to-day.)

Copper, Lead and Rubber Prices.—Messrs. F. Smith and Co. report, December 20th:—Copper (electrolytic) bars, £61 15s., 10s. dec.; ditto ditto sheets, no change; ditto ditto wire rods, £74 15s., 10s. dec.; ditto ditto h.c. wire, no change. Messrs. James & Shakespeare report, December 20th:—No change in prices of copper bars (best selected), sheet, and rod, and English pig lead. Messrs. Edward Till & Co. report, December 20th:—India-rubber, Para fine, 1s. 4½d., ½d. dec.

Book Notices.—"Whitaker's Almanack, 1927." Complete edition (pp. clxxxiii+896), 6s. net; abridged edition (pp. clxxxv+240).—This is the 59th edition of "Whitaker," and it has been almost entirely re-arranged. Those familiar with the usual order of things will, however, secure guidance from the very complete index. The abridged edition replaces the former cheaper "Whitaker," which contained only the first part of the complete almanack. The new volume is an abridgment of the whole, and as such is as good as the larger edition for general information. It has a paper cover, whereas the complete "Whitaker" is bound in boards with a leatherette back.

"Questions and Solutions in Telegraphy and Telephony." By H. P. Few. Pp. 350; figs. 233. London: S. Rentell and Co., Ltd. Price 6s. 6d. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LXV. December, 1926. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

"Surface Water Supply of Canada: St. Lawrence and Southern Hudson Bay Drainage, Ontario. Climatic Years 1923-24, 1924-25." (Pp. 121 and map.) Ottawa: F. A. Acland, King's Printer (for the Canadian Department of the Interior).

Proposed Buenos Aires Subways.—The *Review of the River Plate*, dated November 19th, contained details of the concession proposed to be granted to an Argentine-British group, headed by Lord Ampthill, for the construction of subways in Buenos Aires, a matter to which we have made several references recently. It is proposed that the work shall be carried out in six sections and final plans of the first section are to be submitted within six months of the signing of the contract, and that section must be completed within three years of the commencement of the work. The whole undertaking is to be finished within five years. The concessionaires are required to deposit the sum of $600,000, and various penalties are prescribed for non-compliance with the terms of the contract. The fares to be charged are laid down in the concession, and exemption from municipal taxation is granted. The term of the concession is 90 years, and at the end of that period the whole undertaking is to be handed over to the Municipality without compensation; a sinking fund for repairs and replacement is to be maintained. In commenting upon the concession, our contemporary says: "It would rather appear that the London representatives of the group of capitalists concerned have been inclined to take a great deal for granted! The contract of concession is not by any means a *fait accompli* as yet. The report made by the three members of the committee of five must be posted for fifteen days before it can even be discussed by the City Council, and past experience in respect of the deliberations and resolutions of this body has hardly been such as to justify any automatic presumption that 'it is all over bar the shouting.'"

The Buenos Aires correspondent of *The Times* reported on December 16th as follows:—"At yesterday's session of the City Council the finance secretary, representing the municipal executive, objected to an immediate vote on the proposed Sumner concession for tube railways in the city, on the ground that the financial and technical bases of the proposal required further investigation. He explained that one of the proposed lines traversed a port zone not under municipal jurisdiction."

Reuter reported on December 18th that after two inconclusive ballots the scheme was rejected by the casting vote of the chairman, mainly because it was considered that the syndicate did not offer sufficient financial guarantees. The Council has decided to refer the question to the Municipality for a further and more comprehensive study of the whole matter.

Lighting and Power Notes.

Alderley Edge.—PROPOSED INQUIRY.—The Urban District Council has decided to ask the Ministry of Transport to institute a public inquiry with a view to reducing the present maximum prices charged for electricity by the Alderley and Wilmslow Electric Supply, Ltd., from 10d. to 7d. per kWh for lighting, and to 3d. per kWh for heating and power.

Australia.—VICTORIA.—According to the *Industrial Australian and Mining Standard*, the Victorian State Electricity Commission is extending its transmission lines from Brisbane to Maffra, in connection with which three sub-stations are being erected at Bairnsdale. In the metropolis sub-stations G, H and K, three of five sub-stations planned by the Commission for the purpose of taking over the bulk supply of the load carried in the area, distributed by the Melbourne Electric Supply Co. from Richmond power station, have been put into operation since the presentation of the Sawyer report. With the construction of these sub-stations the system of supply is being changed in the area from single-phase to three-phase.

BURRINJUCK SCHEME.—The New South Wales Public Works Department has issued a report on the progress of the Burrinjuck electricity scheme. The report states that a considerable amount of time was lost in erecting generating plant as the result of large volumes of water which it was necessary to discharge, and to wet weather in July and early in August. Work is now proceeding favourably. All of the excavating for the power station is completed, and the foundation satisfactorily built. Most of the walls have been built 20 ft. above the river bed, the main pipe line between the dam and the power house is completed, and all of the power house machinery has been delivered and is waiting erection early next year. The report states that the erection of the transmission lines were considerably delayed by boggy ground.

Ayrshire.—ELECTRICITY SUPPLY.—The Ayrshire Electricity Board and Largs Town Council have now come to an agreement for the supply of electricity to Largs. The Board will apply for an Order to include Largs in its area of supply and the street lighting will be converted from gas to electricity as soon as it is found expedient.

Bedford.—ELECTRICITY IN BULK.—The Corporation Electricity Committee has recommended that an agreement for the supply of electricity in bulk to the Bedfordshire, Cambridgeshire and Huntingdonshire Electricity Co., be entered into on the following terms:—KW charge: First 200 kW of maximum demand, 10s. per kW per month; over 200 kW, 3s. 4d. per kW per month. "Unit" charge: First 200 kWh per month per kW of maximum demand, .425d. per kWh; all energy in excess of this amount, .3d. per kWh. The "unit" charges are to vary according to cost of coal, and the total account is to be subject to a discount of 25 per cent.

Birmingham.—NEW POWER STATION.—The Electric Supply Committee is taking preliminary steps for the erection of a super-generating station at Hams, near Coleshill. Sidings, with roads and bridges, are in course of construction. According to the *Birmingham Post*, in June last the City Council authorised the committee to proceed with the erection of the first section of this power station, comprising plant with a capacity of 60,000 kW at an estimated cost of £1,336,400. The capacity of the complete station will be 210,000 kW, and it is estimated that the total cost will amount to £3,200,000. Recommendations for the placing of contracts for the provision of buildings and equipment will be made to the City Council at an early date.

MAINS EXTENSIONS APPROVED.—The City Council has approved the recommendation of the Electric Supply Committee to incur an expenditure of £400,000 on general extensions of h.p. and l.p. mains.

Bradford.—MAINS EXTENSIONS.—The Corporation Electricity Committee has recommended further expenditure on extensions of mains up to a total of £20,000.

Carlisle.—LOAN SANCTIONED.—The Electricity Committee has received sanction to the borrowing of £10,000 for mains and services.

Continental.—ICELAND.—The Norwegian Titan Water Power Company, of Oslo, has recently applied to the Government of Iceland for a concession to utilise the River Thjorsaa in Southern Iceland for the generation of electricity. The scheme provides for the eventual establishment of six power stations with a total capacity of approximately 1,000,000 h.p. As a commencement a station of 48,000 h.p. is projected near the Wirida Falls.

Douglas (Isle of Man).—INQUIRY.—Col. T. C. Ekin held an inquiry on December 9th in connection with the application of the Town Council for sanction to borrow money to extend the electricity undertaking. The inquiry was held in private. Recently the Council considered whether oil or steam plant should be installed, and it was decided to adopt steam plant.

Duns.—ELECTRICITY SUPPLY.—The Town Council on December 13th decided to approach one or more firms with a view to ascertaining whether they would be prepared to introduce and control a scheme for the supply of electricity in the town.

East Grinstead.—LOAN.—The Urban District Council has applied for sanction to a loan of £4,300 for carrying an overhead line to Sunnyside pumping station, and to £300 for alterations to the switchboard.

Hastings.—ELECTRICITY SUPPLY.—The Town Council has decided to extend the mains to supply electricity to new wells at Sedlescombe and Kent Street at an estimated cost of £14,478, and to give a supply of electricity to the Palace Hotel and Drapers' flour mill. A loan of £30,800 overspent on the erection of a power station at Broomgrove has been applied for. The sanctions in respect of this work totalled £131,373.

Hereford.—LOAN.—The Electricity Committee has recommended that application be made for sanction to a loan of £2,800 for extending the cable in order to supply electricity to the works of Messrs. Godwin & Thynne, Ltd., Withington. The firm has offered a guarantee of 20 per cent. of the capital cost for five years, and the charge will be £6 per kVA plus .6d. per kWh.

Hull.—PROPOSED NEW POWER STATION.—At a meeting of the Electricity Committee on December 16th, the electrical engineer (Major H. Bell), stated that he was preparing to make a preliminary survey of various sites for the erection of a new power station.

India.—RAIPUR.—The local Government proposes to grant a licence to a Calcutta firm, and to a Khandwa engineer to supply electricity to the City, the water-works station and area, and the B.-N. Railway yard. The licensees are to give a supply within a period of two years, from the date of commencement of the licence.—*Indian Engineering.*

London.—KENSINGTON.—The Works Committee has reported that the 200 street lamps converted from gas to electric lighting about a year ago have proved satisfactory, and it has been decided to proceed with the conversion of a further 300 street lamps.

Lowestoft.—INQUIRY.—The Town Council has been notified that Col. T. C. Ekin, of the Electricity Commission, will hold an inquiry at the Town Hall, on January 18th, into the Council's application for a Special Order authorising it to extend its area of electricity supply. At the conclusion of this inquiry, Col. T. C. Ekin will also hold an inquiry into the Council's application for sanction to extend its generating station and to a loan of £53,000.

Manchester.—PROGRESS DURING OCTOBER.—During the month of October the Corporation electricity undertaking showed an increase in connections of 2,398 kW, bringing the total to 293,862 kW; and the number of applications received for supply, including consumers for additional supplies, was 1,322, representing a total of 3,093 kW. The number of hired cookers connected increased by 135, bringing the total actually on circuit to 2,323. Applications for the hire of cookers totalled 163. Two 1,000-kW convertors were installed at Rusholme and Openshaw sub-stations, one 750-kW rotary convertor at Didsbury, and a 100-kVA unit at Audenshaw was replaced by one of 250 kVA.

Milnrow.—PRICE REDUCTION.—The Electricity Committee is to reduce the charge for electricity for lighting purposes from January 1st next to 5½d. per kWh.

Newark.—INAUGURATION OF SUPPLY.—An electricity supply for the town was formally inaugurated by the Mayor on December 16th. Electricity is obtained from the Derbyshire and Nottinghamshire Electric Power Co., and is transmitted from Kirkby-in-Ashfield, a distance of 24 miles. The electricity charges are:—Lighting: 7d. per kWh. Heating: First 50 kWh 2½d. per kWh; for all energy in excess of this amount 2d. per kWh. Power: 3d. per kWh.

Price Increases.—Owing to the higher cost of coal, increases in the charges for electricity have been made or recommended in the following districts:—

HASTINGS.—An increase of 12½ per cent.

SWANSEA.—Lighting: Flat rate from 5½d. to 6d. per kWh; maximum demand system, war increase from 20 to 50 per cent. Heating and cooking: Summer period from 1d. to 1¼d. per kWh; winter period from 1½d. to 2d. per kWh. Power: War increase from 12½ to 50 per cent.

Ruthin.—ELECTRICITY CHARGE.—The Town Council has decided to apply to the Ruthin Electricity Supply Co., Ltd., for an immediate reduction in the charge of electricity for lighting, which is at present 11d. per kWh, and failing the granting of the request to approach the Electricity Commissioners for an inquiry into the matter.

St. Austell.—ELECTRICITY SUPPLY.—At a recent meeting of the Rural District Council an application was received from the St. Austell & District Electric Lighting & Power Co., Ltd., for permission to erect overhead lines for the purpose of supplying Tywardreath with electricity. The Council has refused to permit the erection of overhead lines, as it is contended that they would mar the amenities of the district, but it intimated that there would be no objection to underground cables.

St. Neots.—ELECTRICITY SUPPLY.—The Rural District Council has given permission to the Bedfordshire, Cambridgeshire & Huntingdonshire Electricity Co. to erect overhead lines for the transmission of electricity in its area.

South-West Midlands. — ELECTRICITY SUPPLY. — The *Evesham Journal* reports that the Shropshire, Worcestershire and Staffordshire Electric Power Co., has commenced work on the erection of a 66,000-V transmission line from its power station at Stourport, which will at present terminate near Tewkesbury, where the electrical energy will be reduced to a pressure of 11,000 V for distribution to towns and villages, and again further reduced for domestic use. This trunk main will be inter-connected with the line already supplying into the Evesham district, and will form a ring main commencing at Stourport, *via* Tewkesbury, Pershore, Evesham, Redditch, Bromsgrove, Smethwick, Oldbury, and Halesowen, back to Stourport. A similar line to terminate in the Ludlow area to supply throughout the county of Shropshire is to be commenced early in the new year.

Sunderland.—NEW SUB-STATION.—The Town Council has decided to erect a new sub-station in Fulwell Road at an estimated cost of £5,900, and application is to be made for sanction to borrow this sum.

Walsall.—MAINS EXTENSIONS.—The mains on the Leamore housing estate are to be extended at an estimated cost of £2,620.

Watchet.—ELECTRICITY SUPPLY.—The Minehead Electric Supply Co., Ltd., has informed the Urban District Council that as it has not lodged any objection and decided that the matter should remain in abeyance, it is proposed to apply to the Electricity Commissioners to dispense with the Council's consent to the Order authorising the company to supply electricity in the Council's area.

Wolverhampton.—ELECTRICITY EXTENSIONS.—The Electricity Committee has recommended to the Town Council that application be made for sanction to a loan of £1,876 for extension of the mains in the Shareshill district. It has also recommended that the electricity supply be extended to Brewood and the works of the Four Ashes Manufacturing Co., at an estimated cost of £3,414.

Worksop.—INAUGURATION OF EXTENSIONS.—The Urban District Council's electricity extensions were formally inaugurated on December 16th by the wife of the chairman of the Electricity Committee and the wife of the chairman of the Council. The new plant consists of two Vickers-Petter 510/550-b.h.p. heavy-oil engines, driving two 320-kW, 460/550-V, Metropolitan-Vickers, shunt-wound, interpole, d.c. generators. The plans and specifications for the extensions were prepared by Mr. F. L. Pedley, manager of the electricity undertaking.

Tramway and Railway Notes.

Australia.—SOUTH AUSTRALIAN TRAMWAYS.—The statement of receipts and payments of the Adelaide Municipal Tramway Trust for the six months ended July 31st last, shows that the total revenue was £361,878, and the operating expenses £272,609. Reserves for renewals absorbed £18,832, interest £64,497, and sinking fund £5,738. According to the Tramways Act, the Trust has to repay the money advanced by the South Australian Government for conversion and development purposes in 60 half-yearly instalments. Up till July 31st, 1924, the full amount due was paid into the sinking fund, but since that date the sum of £144,787 has fallen into arrears. Out of an amount of £49,378, due to the sinking fund for the half-year under review, only £5,738 was repaid, leaving a deficit of £43,640.—*Industrial Australian and Mining Standard.*

Bradford.—PARLIAMENTARY BILL.—*The Times* reports that the Corporation proposes to promote a Bill giving it powers to take over three or four miles of route between Baildon Bridge and Guiseley, over which Leeds Corporation has running powers, when the latter constructs a railless-car system. The erection of overhead equipment, it is claimed, would disfigure the countryside. The Bill also seeks powers to run omnibuses in Wharfedale, and if these powers are granted, there is little likelihood of the railless-car system being inaugurated between Baildon Bridge and Guiseley.

TRAMWAY FARES.—The City Tramways Committee is to discuss the question of the advisability or otherwise of an all-round reduction in tramway fares. It is understood that the question has been raised by the prospect of a deficit on the present year's working and the hope that reduced fares might induce more business.

Glasgow.—HEATING OF TRAMCARS.—The Corporation Tramways Committee has decided as an experiment to install pipes on 12 tramcars, which will convey the heat generated from the resistance on the platform to the lower and upper decks of the cars. If the scheme proves successful it will be adopted on all the Corporation's tramcars.

Heywood.—PROPOSED LINKING-UP.—The Town Council has decided to enter into an agreement with the Middleton Corporation for the construction of a light railway between the two districts. When this scheme is completed the local services will be linked up with Manchester.

London.—TRAMWAY JUNCTION.—The Highways Committee of the L.C.C. has recommended the construction of a tramway junction to connect the tramway in Brockley Rise with the line proceeding toward Catford. The cost of the scheme is estimated at £5,500.

Middlesex.—TRAMWAY LEASE.—At a meeting of the County Council on December 16th, the report of a conference with the Metropolitan Electric Tramway Company, Ltd., which has declined to renew the present lease for operating the system when it expires in four years, was received. Mr. Garcke informed the conference that the company estimated a deficit of £150,000 a year on the three years ending 1926, and it could continue only if reasonable conditions as to competition were set up by co-ordination of traffic facilities.

New Zealand.—RAILWAY ELECTRIFICATION.—The *Australasian Electrical Times* reports that the electrification of the Lyttleton railway tunnel, between Christchurch and Lyttleton, will be put in hand shortly, at a total estimated cost of £193,440. It is expected that work will be commenced in March, 1927. Some of the principal items of cost are: Electric locomotives, £61,200; overhead equipment of 22 miles of single track, £60,000; sub-station at Woolston, £30,000; alterations to engine shed, telegraph and telephone requirements, &c., £10,000; contingencies (20 per cent.), £32,240.

Stoke-on-Trent. — MOTOR OMNIBUSES. — The *Manchester Guardian* reports that the Potteries Electric Traction Co., which has a monopoly of tramway traffic in the Potteries, is desirous of replacing tramcars by omnibuses. At a recent meeting of the Corporation Watch Committee, a communication was received from the company threatening to appeal to the Ministry of Transport unless the Corporation granted it more omnibus licences. The company also asked that its omnibuses, instead of being restricted to specific routes, should be permitted to operate over any of the existing tramway routes. The matter was referred to the Hackney Carriage Sub-committee. At the same meeting the Watch Committee decided to grant the tramway company four omnibus licences on the Victoria Road route between Hanley and Longton, subject to its relinquishing all its tramcars on this route, removing the tramway track, and restoring the road satisfactorily.

Telegraph and Telephone Notes.

Australia.—TELEPHONE DEVELOPMENTS.—With the enormous growth which has taken place in the city of Melbourne in recent years has come the necessity for an enlarged telephone system. For some time past, the old suburban manual exchanges have been undergoing a change to the automatic system, and the Postmaster-General's department, it is understood, has almost completed plans for the complete reorganisation of the ceneral exchange at a cost of over £1,000,000. Another interesting step was the recent completion of a connection between Melbourne and Townsville (Queensland), a distance of 2,017 miles. This is said to be one of the largest lines in the world; satisfactory tests have been made, and the line is now open for public use. When the service is extended from Melbourne to Adelaide and from Townsville to Cairns (which work is at present under way), a call between Adelaide and Cairns will stand as a world's record.—*Reuter's Trade Service* (Melbourne).

Austria.—TELEPHONE SERVICE.—Interesting particulars are given in the recently-issued report for 1925 of the Austrian Posts, Telegraphs and Telephones Department regarding the extensions undertaken during the year. For the first time porcelain insulators of Austrian manufacture were used, to the extent of approximately 290,000 pieces. The work of changing over the Vienna telephone system to automatic operation, commenced before the war, was completed, and 6,000 new subscribers connected in 1925. There are now about 70,000 telephone subscribers in Vienna, who are served by thirteen exchanges, the largest having 10,000 connections and the smallest 1,000. A new automatic telephone exchange has been completed in Linz; one is approaching completion in Salzburg, while work on one in Neustadt, Vienna, has been started. New international telephone connections have also been established between Vienna and Warsaw, Vienna and Pressburg, Vienna and Agram, and between Kufstein and Oberaudorf.

Czecho-Slovakia.—LONG-DISTANCE TELEPHONY.—Direct telephone connection between Prague and Trieste is about to be opened. The Czecho-Slovakian and Austrian sections of the line have been available for a considerable time, but there has been delay in completing one portion of the Italian section. This difficulty has now been overcome, and the final tests are now being made.

Danzig.—TELEPHONE LOAN.—The Free State of Danzig is negotiating for a loan, a portion of which, amounting to about $487,000, would be granted to the telephone administration for the installation of an automatic telephone system and for other improvements, according to *Commerce Reports*.

Japan. — NEW RADIO-TELEGRAPH SERVICE. — The Osaka station is now regularly receiving direct wireless messags from the Sainte Assise wireless station near Paris. This service was commenced in September, 19 6. Formerly messages were sent from the Bordeaux station indirectly to the Iwaki station in northern Japan, and were confined to news dispatches.

Madeira.—CYCLONE.—A hurricane on December 15th is reported to have caused considerable damage. News was transmitted by the naval radio station, as the Marconi station is stated to have been "greatly damaged" and the submarine cable telegraph service was interrupted. The cable service between Madeira and London was restored during the evening of December 17th.

Poland.—RADIO COMMUNICATION.—The Commercial Secretary at Warsaw (Mr. R. E. Kimens) has forwarded to the Department of Overseas Trade a brief survey regarding development in Poland. For communication with foreign countries the Post Office is in possession of four stations:—The transatlantic station has been built with the assistance of the Polish emigrants in America by the Radio Corporation of America. The transmitter consists of two 300-kW alternators, which can work both in parallel on a very good elaborated aerial. This station was designed for high speed, but as the actual number of words available for transmission is only between 700-1,000 daily, the running expenses are so high that special credits must be voted by the Diet to cover the losses. The greater part of the cost of the station is paid off, with the exception of an outstanding sum of approximately Z100,000, which has to be paid off within six years. Second and third stations are the arc transmitters at Cracow and in Poznan; they only permit of hand-speed working, and are used for communication with European countries. A French alternator station of approximately 6 kW at Grudziadz is also used for communication with European countries, especially with France; the last-mentioned three stations are "extremely inefficient" and are not equipped with modern receivers. Only a small part of correspondence which could be transmitted from and received in Poland is going by wireless.

Portugal.—NEW WIRELESS TELEGRAPH SERVICE.—A direct high-speed wireless telegraph service between England and Portugal was opened on December 15th. It is the first of a number of wireless telegraph services which are being established by the Portuguese Marconi Company under a 40 years' concession granted by the Portuguese Government to Marconi's Wireless Telegraph Co., Ltd., to undertake the organisation of a complete wireless telegraph and telephone system to place Portugal in communication with her Colonies, the principal capitals of Europe, South America, and other countries. Stations are being built near Lisbon, in Cape Verde Islands, Maderia, the Azores, Mozambique, and Angola. One of the group of transmitting stations to be erected at Alfragide, near Lisbon, and one of the corresponding receiving stations at Vendas Novas will work at high speed with the Marconi stations at Ongar and Brentwood, near London, and with the principal capitals of Europe; another will communicate with the Portuguese Islands and with ships at sea, and short-wave "beam" stations are also being built for communication with Brazil and other parts of South America, and the Portuguese Colonies at Mozambique and Angola, where similar beam stations are being constructed. The services inaugurated last week are those between Lisbon and London, Maderia, and the Azores.

Radio Notes.

Australia.—LICENCES.—According to a return issued by the Director of Postal Services, the total number of wireless listening licences held in Australia is 175,208. New licences to the number of 10,796 were issued last month; Victoria stands out from the other States with over 89,000. The ratio of licences for every 100 of population of the Commonwealth is now 2.9, of Victoria 5.28, and of New South Wales 2.04.—*Reuter's Trade Service* (Melbourne).

France.—CONTROL PLAN.—M. Bokanowski, Minister of Commerce, who recently described as "anarchic" the conditions under which French broadcasting is carried on, prepared a scheme of control with a view to placing broadcasting in the hands of properly constituted and authorised organisations. The Superior Council of the Post Office Department, an advisory body to which M. Bokanowski submitted the scheme, has refused to regard the matter as urgent and decided not to discuss its details for the present. In an official note the Ministry of Commerce, which seems, says *The Times*, to have yielded to this ruling, observes that broadcasting will therefore continue "to await in anarchy its permanent regulation."

Holland.—STANDARDISATION.—Dutch wireless dealers are organising an effort for the standardisation of parts and fittings, and also of the technical terms used with regard to wireless.

Irish Free State.—LICENCES.—The number of wireless receiving licences issued in the Free State up to the end of November was 4,544, of which number 430 were issued during November.

New Relay Post.—GLOUCESTER LINE.—The Gloucester line-relay station of the B.B.C., which is part of the extensive simultaneous broadcast system, is now in service. The station, which affects the Plymouth, Cardiff, Swansea, Birmingham, and Stoke radio transmitters, is merely a distributing point. For instance, when a news bulletin is being read in London, it goes by Post Office trunk lines direct to Gloucester, where the quality of speech is improved by correction circuits, and after reamplification is distributed.

Poland.—DEVELOPMENT.—H.M. Commercial Secretary at Warsaw informs the Department of Overseas Trade that the exploitation of broadcasting in Poland is in the hands of a private company with Government participation in 40 per cent. of the share capital. The concession is for 10 years and the Post Office is collecting licences; the fee is Z30 per year, or Z3 monthly; 25 per cent. of the licence fees is retained by the Post Office and 75 per cent. is handed over to the company. On the formation of the company arrangements were made to erect one broadcasting station for Warsaw of half the power of Daventry, and one smaller station (6 kW) for Cracow. The opening of the Warsaw station took place in the spring of 1925. In spite of the summer season the rush of applications for licences shows keen development. At present the number of issued licences amounts to 30,000. The collected fees are quite sufficient to run the Warsaw station without losses, with a quite good programme. Taking into consideration this quick development, it has been decided by the company to erect two additional transmitters, one in Poznan, the second in Katowice, and a considerable number of new transmitting stations, some as relays, are proposed for the beginning of the next year.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia. — SYDNEY. — January 26th, 1927. New South Wales Government Railways. Electric railway car equipments, consisting of motors, control equipment, air compressors, pantographs and accessories (Spec. 1065). (A.X. 5810.)*

Brighton.—January 7th. Tramways Department. 125 tons B.S. No. 7 steel girder tram rails. Forms of tender from the Tramways Engineer, Lewes Road, Brighton.

Burnley.—January 27th. Tramways and Omnibus Department. General stores for 12 months. Schedules from the General Manager, Queensgate Depôt, Burnley.

Dublin.—January 4th. Electricity Department. One surface condenser, with auxiliary plant. (December 17th.)

East Ham.—January 1st. Tramways Department. 10 double-deck bogie tramcars complete, or bodies and top covers with assembly of material; motor equipment; controller equipment; maximum traction swing bolster bogie trucks, magnetic track and hand brake equipment. (December 10th.)

Egypt.—CAIRO.—January 10th, 1927. Ministry of Public Works, Mechanical Department. Electrical generating plant for Giza. (B.X. 3079.)*

Fort William.—February 1st. North British Aluminium Co., Ltd. Water turbines (impulse type) and d.c. generators for the Lochaber water power scheme. (December 10th.)

Huddersfield.—January 5th. Education Committee. Electric light installation, open-air schools, Woodhouse Hall. Borough architect, 26, Ramsden Street.

Hull.—January 20th, 1927. Electricity Committee. Two 12,500-kW turbo-alternators and condensing plant. (December 17th.)

India.—India Store Department. January 4th, 1927. 264,650 (approx.) copper bonds for track rails. (November 26th.)

January 21st, 1927. Circulating-water pumps, screens, and pump-house equipment, including delivery and erection in India. (December 10th.)

February 4th, 1927. 11 complete traction sub-stations and track-sectioning cabin equipments, including delivery and erection in India. (December 10th.)

January 11th. Bombay, Baroda and Central India Railway Co. Crude oil engine generator sets. Specification (10s.) from Mr. S. G. S. Young, Secretary, 91, Petty France, Westminster, S.W.1.

January 7th. South Indian Railway Co., Ltd. Overhead transmission line material and cables and water cranes. Specifications from The Secretary, 91, Petty France, S.W.1.

Liverpool.—January 19th. Electricity Supply Department. 250,000 tons best quality steam slack during the 12 months to March 31st, 1928. Forms from the City Electrical Engineer.

London.—ISLINGTON.—January 21st. Electricity Department. Twelve months' supply of electrical and engineers' stores, including cables, meters, electrical sundries, lamps, transformers, and cable terminal, service, network and fuse boxes, circuit breakers, &c. (December 10th.)

Manchester.—January 3rd, 1927. Electricity Committee. 33,000-V, 420-V, and 240-V switchgear. (November 26th.)

Meltham (near Huddersfield).—December 31st. Wiring, fittings, &c., required in the electric lighting of the Parish Church. Particulars from Mr. W. R. Carter, secretary, Church Council, Birchfield, Meltham.

New Zealand.—WELLINGTON.—Public Works Department. February 15th, 1927. Transformers for Waikato. (B.X. 2985.)*

February 14th, 1927. Government Railways. Switchgear, armoured cable and accessories, motor-generator sets, filament lamps and reflectors. (B.X. 3078.)*

DUNEDIN.—February 19th. City Corporation Gas Department. One motor-generator with control board and accessories. (B.X. 3095.)*

Nottingham.—December 31st. Electricity Department. Two 30-in. electrically-driven pumps, one motor-driven twin booster, one 256-cell storage battery. (November 19th.)

South Africa. — PRETORIA. — February 3rd. Municipal Council. E.h.p. cable and accessories, switches and cut-outs. (B.X. 3097.)*

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Bexhill.—Electricity Committee. Accepted:—
500 yd. of .0225 twin service cable (£82).—Enfield Cable Works, Ltd.

Chesterfield.—Electricity Committee. Accepted:—
Cable.—£473, Macintosh Cable Co., Ltd.; £618, W. T. Glover & Co., Ltd.; and £175, Standard Telephones and Cable Co., Ltd.
100-kVA transformer (£130).—Brush Electrical Engineering Co., Ltd.
Grit arrestor (£475).—Tipton Tub and Tube Co., Ltd.

Irish Free State.—The undermentioned contracts were placed by the Irish Free State Government Departments from October 26th to November 24th:—

COMMISSIONERS OF PUBLIC WORKS.
Mercantile Marine Office, Eden Quay, Dublin (electric lighting).—Gleeson, O'Dea & Co., Ltd.

CONTROLLER OF STORES (POSTS AND TELEGRAPHS).
Battery boxes.—G. Perry & Co., Ltd.
Bell gongs.—Telephone Manufacturing Co., Ltd.
Boiler.—Hadens Engineering Co., Ltd.
Bridge meggers and resistance box.—Evershed & Vignoles, Ltd.
Cable (lead covered).—Enfield Cable Works, Ltd.; Standard Telephones and Cables, Ltd.
Cells (dry).—Le Carbone.
Cells (secondary).—Pritchett & Gold and E.P.S. Co., Ltd.
Earth plates.—J. and C. McGloughlin, Ltd.
Generators.—Peel-Conner Telephone Works.
Telegraph poles.—T. and C. Martin, Ltd.; F. Routledge.
Wire (bronze).—Perrins, Ltd.; S. A. des Cableries et Trefileries.
Wire (copper).—Pirelli-General Cable Works, Ltd.; R. Johnson and Nephew, Ltd.

DUBLIN.—City Electric Lighting Department. Recommended:—
One 5,000-kW steam turbo-alternator (£16,073).—Oerlikon, Ltd.

Electricity Department. Accepted:—
80 flame arc lamps (£1,000).—Photector Co., Ltd.

Lamp Contracts.—The Admiralty has placed contracts for 200,000 Osram gasfilled and vacuum lamps and 15,000 special Robertson carbon-filament lamps with the General Electric Co., Ltd., and a contract for carbon-filament and metal-filament gasfilled lamps with the Edison Swan Electric Co., Ltd.

Maidstone.—Kent County Council. Accepted:—
Wireless installation at the Mental Hospital at Barming.—J. W. See and Sons.

New Zealand.—AUCKLAND.—In spite of the fact that a German tender was more than £400 less than the lowest British tender, the Auckland Power Board decided to adhere to its policy of preference for British goods, and has given the contract at £1,100 for triple braided cable to a British firm.—*Reuter.*

Forthcoming Events.

Junior Institution of Engineers.—Friday, December 31st. 39, Victoria Street, S.W. 7.30 p.m. Questions and General Technical and Practical Discussions.

Salford Technical and Engineering Association.—Monday, December 27th. Royal Technical College. 7 p.m. Annual social.

Royal Institution of Great Britain.—21, Albemarle Street, W.1. 3 p.m. Juvenile Christmas Lectures. Professor A. V. Hill on "Nerves and Muscles: How We Feel and Move." (1) Tuesday, December 28th, "Nerves and the Messages they Carry; (2) Thursday, December 30th, "Muscles and How They Move"; (3) Saturday, January 1st, "The Heart and some other Muscles."

Notes.

The Electrical Engineers' Ball.—As usual we publish below the names of the General and Executive Committees and officers for the next Electrical Engineers' Ball (the eighteenth) which, as already announced, is to be held on Friday, February 11th, 1927, at the Hotel Cecil:—

General Committee:

Addenbrooke, G. L.
Alabaster, H.
Alabaster, G. H.
Andrews, Leonard
Atkinson, Lt. B.
Baldwin, O. H.
Balfour, George, M.P.
Bowden, J. H.
Callender, Sir T. O., J.P.
Chattock, R. A.
Cramb, A. C.
Cridge, A. J.
Couzens, H. W.
Elder, T. C.
Fairman, H. W.
Ferranti, Dr. S. Z. de
Fox, E. J.
Gatehouse, E. A.
Gill, Frank
Gillespie, M. M.
Gray, James
Gregory, J. P.
Gridley, Sir Arnold, K.B.E.
Hadley, A. E., C.B.E.
Highfield, J. S.
Hill, C. W
Hirst, Sir Hugo, Bt.
Hunter, P. V., C.B.E.
Hughman, R. W.
Kennal, Sir James, K.B.E.
Kerr, M. J. D.
Kingsbury, J. E.
Knight, C. M.
Leaf, H. M.
Leigh, Lt.-Col. F. A. Cortez
Lonsdale, W. Stanley
McGregor, J. J., C.B.E.
McKinstry, A. E.
McKay, H. J. S.
McClelland, Wm., C.B.
McMahon, P. V.
Mason, A. V.
Matthews, W. Lee
Midgley, H. E.
Mordey, W. M.
Moss, E. W.
Nalder, F. H.
Nash, Sir P., K.C.M.G., C.B.
New, E. S.
Noble, Sir Wm.
Partridge, G. W.
Pooley, F.
Purves, Col. T. F.
Railing, M. J.
Riley, G. E.
Robinson, L. L.
Rogers, F. M.
Rowell, P. F.
Sayer, C. E.
Scholey, H., C.B.E.
Shaughnessy, E. H.
Siddeley, H. C.
Sillar, A. M.
Snell, Sir John, C.B.E.
Sutton, Sir George, Bt.
Taite, C. D.
Taylor, G. M. C.
Taylor, James, J.P.
Tresize, J. M. G.
Wallis-Jones, Capt. R. J.
Walton, A. H.
Wilson, David
Woodhouse, W. B.
Worsdell, F. E.

Executive Committee:—O. H. Baldwin, H. W. Couzens, C. W. Hill, J. E. Kingsbury, W. S. Lonsdale, P. V. McMahon, A. M. Sillar, R. J. Wallis-Jones, A. H. Walton.

Hon. Secretaries:—A. M. Sillar and C. W. Hill.

Hon. Treasurer:—J. E. Kingsbury.

A Diesel-Electric Installation.—An interesting Diesel installation is to be put down in the tobacco factory of Messrs. John Player & Sons, Nottingham, for the supply of electricity in the works. Two 600-b.h.p., 250-r.p.m. engines are being supplied by Messrs. Mirrlees, Bickerton & Day,

Ltd., which will drive generators to be supplied by the British Thomson-Houston Co., Ltd. Each engine is of the air-injection type, has six cylinders, 17¼-in. bore, 20-in. stroke, and has, it is claimed, an overload capacity of 10 per cent. Careful consideration has been given to the possibility of any fumes from the engines in any way affecting the tobacco, and, as a result, the engines are of the totally-enclosed type, and part of the suction air is taken from the crankcase; thus any crankcase fumes are drawn into the cylinders without polluting the atmosphere of the engine room. The crankshaft is very substantial, and its main bearings and the connecting rods are forced lubricated by a simple valveless plunger pump driven from the crankshaft. A small hand pump is also provided for priming the bearings and pipes before the engine is started up. The connecting rods are of an unusual length, 5.65 times the crank radius. Although the use of such long rods has increased the cost of manufacture and the height of the engine, the following advantages are claimed as a result:—Reduced forces which tend to cause vibration; a reduction of the lubricating oil consumption, as less oil is "splashed" on the cylinder walls; and a decrease in the horizontal thrust of the piston on the cylinder walls.

The pistons are of a special cast-iron and fitted with "Mirrlees" floating-type gudgeon pins and the improved top-end bearings. The gudgeon pin rotates freely, improving the lubrication and evenly distributing the wear. The air compressor is of the three-stage type and driven in the usual manner from the main crankshaft. The fuel valves are of the "Mirrlees" patent packingless type, and are claimed to be immune from the possibility of sticking. The exhaust pipes are water-cooled.

A 120,000-Volt Transmission Line.—Some interesting particulars are given in a recent issue of *L'Energia Elettrica* of the new 120,000-V electric transmission line which has lately been established between Leghorn and Florence, a distance of about 51 miles, by the Società Elettrica del Valdarno, of

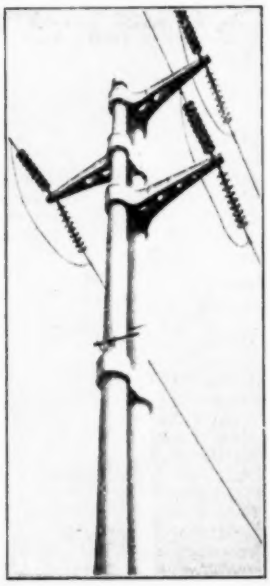


Fig. 1.

Fig. 2.

120,000-V Transmission Line Poles in Italy.

the last-named city, and the Società Ligure Toscana di Elettricita, of Leghorn. In recent years the Florence undertaking has considerably extended its sphere of operations in Eastern Tuscany, and it is with the object of ensuring a continuous supply, in the event of a breakdown or suddenly-increased demand, that the new transmission line has been erected to supply from 30,000 to 50,000 kW from the new steam-operated power station which the Leghorn Company is establishing at Marzzocco. This new plant will also supply energy to industrial districts along the west coast of Italy between Grosseto and Spezia, and in the interior of the province to Lucca, Santa Maria, and Siena.

It is claimed for the new line that it is the first high-pressure line in the world to be supported throughout on ferro-concrete masts. These are hollow tapered poles, made by the Società S.C.A.C. at its Mori works, and have plain exterior surfaces throughout, the line-supporting brackets being clamped in position. The masts vary in length from 68 to 82 feet, and weigh from 5 to 6 tons each. The question of their transport both by rail and road was consequently a matter that called for careful consideration. For the rail transport two special low-platform trucks were coupled together, while for transport along the roads in the valley of the River Arno, in which the line has been erected, the poles were slung from large-diameter, two-wheel trolleys and hauled by motor tractors, the latter being also used for the erection of the masts. Fig. 1 is a view of the upper end of a double 68-ft. mast, showing the method of mounting the brackets, and fig. 2 shows two single masts employed for a railway crossing.

Birmingham Electric Club.—The report of the committee for the past session shows that there is a total membership of 237, embracing representatives of all branches of the electrical industry; during the year two members resigned and 26 new ones were elected. The financial position is sound. The attendance at meetings was exceptionally good, but the summer outing could not be held owing to the general strike. Fifty members competed in the snooker handicap.

Fatality.—Duncan Richardson, electrical engineer, of Bannockburn, received a fatal electric shock recently while working in the power house at Carlock Colliery, near Stirling.

Tidal Power from the Tay.—Prof. Angus R. Fulton, Professor of Engineering, University College, Dundee, in the course of a lecture on December 9th, under the auspices of the Dundee Sub-Centre of the Institution of Electrical Engineers and the Dundee Institute of Engineers, outlined proposals for harnessing the River Tay for the purpose of obtaining electricity and for the provision in connection with the scheme of a road bridge over the Tay. The estimated cost of the scheme was given at £1,450,000. Prof. Fulton, whose subject was "Tidal Power from the Tay," said that a dam across the river between Broughty Ferry and Tayport would impound to the westward many square miles of water area, but the effect on the harbour and the shipping trade of Dundee at once ruled that out as impossible. However, the well-known Invergowrie Bay, stretching from the west end of the Esplanade to Port Allen, Errol, seemed admirably adapted for enclosure, the area included being about nine square miles. Worked on the two-basin system, each basin of 4½ square miles, 11,700 h.p. would be continuously available. This involved the construction of a sea wall approximately nine miles long to enclose this area, with the necessary sluices, and a deviation wall between the high- and low-level basins with the power house and plant. The estimated cost was:—Constructional work, main walls, &c., £1,200,000; turbines, generators, &c., £250,000; which worked out at an estimated cost of about £124 per horse-power, which was a very high figure for water power. The cost of developing water power in some cases might be as low as £10 per h.p., a very exceptional case, while £60 might not be prohibitive where coal was dear. In New Zealand the estimated cost of schemes aggregating 3,800,000 h.p. averaged £31 per h.p. before the war, and Kinlochleven, with its approximate 19,000 kW, cost £588,000, or about £30 per kW. A wide margin, therefore, remained before a tidal scheme as proposed became economically a reasonable proposition. Speaking of an alternative proposal, Prof. Fulton referred to the fact that a proposal to build a road bridge over the Tay at Dundee had been seriously entertained by the Government. So far as providing a through road route to Edinburgh was concerned, the proposed sea wall could be converted into an embankment carrying a roadway 100 ft. wide. The additional cost of widening the wall and making it a suitable first-class highway with a promenade and accommodation for tramcars would probably be £350 000, to which must be added the cost of the bridge and its approaches, say, £500,000. This brought the gross total to the very considerable sum of £2,300,000. The assets would include a new uncongested main road to Dundee from the south. The area enclosed would be a magnificent stretch of water on which boating and sailing could be enjoyed, and which, without detriment to its usefulness as a power producer, could be rendered more picturesque than at present. If the costs were apportioned between transport and power on a 50 per cent. basis, the cost per horse-power would be less than £100, and the proposition would come well within the region of practical politics.

In a discussion which followed, Mr. D. H. Bishop, Dundee Corporation electrical engineer, said it was difficult to get a market for power at times when it was not particularly wanted. He was of opinion that they could get the same extra capacity by enlarging any existing big station at a cost of £180,000. If in the future the price of coal rose as it had risen during the coal miners' strike, the scheme might come within the region of practical politics.

Electric Heating at the Zoo.—The Heating Department of the General Electric Co., Ltd., has been engaged for some time on an original scheme of electric heating at the London Zoological Gardens. The work has involved considerable research into automatic thermal control, and the installation has presented many difficulties, but it is claimed that the complete scheme will place the Zoo far in advance of any similar institution in the world with respect to its heating arrangements. Special patterns of electric heaters designed for use in required positions, comprising conduction and radiation patterns, have been placed in the new reptile house. Every electric heater or cage will be under automatic control. Excellent progress has been made also with the new crocodile beach. When this is finished the crocodiles will be able to swim in electrically-heated water, crawl over electrically-heated sand, lie on electrically-heated rocks, and bask in electric light with a close resemblance to tropical sunlight. The Monkey House is another section of the Zoo to which attention is being directed.

Junior Institution of Engineers.—At a meeting on December 10th, Mr. C. E. Foster described some experiments which he had recently carried out with a pyrometer for the purpose of measuring temperatures within the cylinders of internal-combustion engines of motor-car engine size. He had devised an arrangement whereby the sparking plug was made

to serve a dual function as a part of the ignition system, and also as a thermocouple. The central electrode was altered so as to comprise a central core within an annular sleeve, the two parts being of different metals and being insulated from each other except at the tip or sparking point where they were welded. Wires were connected from the core and sleeve to the usual reading instrument. Experiments with this arrangement showed that a reliable reading of a certain average temperature inside the cylinder could be obtained, and that the heat of the spark did not affect the reading more than 20 deg. C.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.)

Mr. WALTER WHITE, who, on demobilisation, joined the Western Electric Co., now Standard Telephones and Cables, Ltd., has been appointed chief engineer at Buenos Aires where the automatic telephone system is being installed, and he sailed on December 16th.

The *Electrical Railway and Tramway Journal* states that in connection with the retirement of Mr. JAMES DALRYMPLE from the general managership of the Glasgow Corporation Tramways, the heads of the other municipal departments have made tentative arrangements to give him a complimentary dinned at the Grosvenor Hotel, Glasgow, on Monday, January 10th.

A complimentary dinner to Mr. G. D. RIEDEL and Mr. N. VAN AUSDAL, respectively European manager and chief engineer of the Delco-Light Company, was held at the Trocadero, London, on December 10th. Speeches that were made indicated the remarkable progress that has been made by "Frigidaire" apparatus in this country in the last year or two.

Mr. F. H. FRANCIS, M.I.E.E., has been presented with a gold watch and chain to mark the occasion of his completion of 25 years as chief engineer of the Oxford Electric Co., Ltd. The presentation was made on December 3rd, in the presence of a large number of employés by Col. G. I. Phillips, the chairman and managing director of the company, who congratulated Mr. Francis on bis 36 years' service with the company, the last 25 years of which had been spent as stated.

The Hull Electricity Committee is considering the question of the salary of the borough electrical engineer, Major H. BELL. It is at present £1,000 and bonus, and he has asked for it to be increased to £1,850, with three annual increments of £50, up to £2,000. According to the *Yorkshire Post*, the Committee is inquiring into the salaries paid in other cities of similar size.

Fulham Borough Council Electricity and Lighting Committee recommends that Mr. A. MURDOCH, station superintendent, be promoted to the position of power house engineer, at the salary of £700 per annum; that Mr. T. WELCH, repairs and shift engineer, be promoted to the position of assistant station superintendent, at the salary of £472; and that Mr. J. F. WHITE, mains superintendent, be appointed mains superintendent under the new scheme at the salary of £620 per annum, all the above appointments to take effect as from December 23rd, 1926.

Mr. LEONARD NEWITT, O.B.E., head of the electrical department of Chatham Dock Yard, who is retiring on pension, has been presented by those engaged in the department with a grandfather clock, a silver kettle, a canteen of cutlery, a silver cigarette case, and an illuminated address.

Obituary.—MR. L. M. ERICSSON.—We regret to learn that Mr. L. M. Ericsson, the well-known Swedish telephone inventor and engineer, died on Friday last, at the age of 80 years. Mr. Ericsson was the founder, in 1876, of the organisation bearing his name, and was one of the world's pioneer manufacturers of the commercial telephone. He commenced business in a very small way, but his operations rapidly grew until his interests assumed their present very large proportions. In this and other countries the Ericsson concern employs many thousands of workpeople.

MR. J. HOOLEY.—The death took place, on December 12th, of Mr. James Hooley, who had for over 20 years been assistant electrical engineer at the Crewe Corporation Works. He was 45 years of age.

New Companies Registered.

Page Electrical Equipments, Ltd. (218,237).—Private company. Registered December 10th. Capital, £500 in £1 shares. Objects: To carry on the business of electrical, mechanical and general engineers, &c. The permanent directors are:—D. G. Page, "Penley," While Road, Sutton Coldfield; Mrs. Ellen M. Page, "Penley," While Road, Sutton Coldfield. Qualification, 1 share. Registered office: 152, Great Charles Street, Birmingham.

Automatic Rectifiers, Ltd. (218,158).—Private company. Registered December 13th. Capital, £6,000 in 5,500 8 per cent. cumulative preference shares of £1 each and 10,000 ordinary shares of 1s. each. Objects: To carry on the business of manufacturers and sellers of articles for charging batteries from alternating current, &c. The first directors are:—Betty Ricketts, Bury Manor, Mury, Sussex; A. Barnett, 269, Mile End Road, E.1; F. T. Smith, 52, Bedford Square, W.C.1. Qualification, 1 share. Secretary (*pro. tem.*): W. Symons. Solicitor: E. M. Tringham, 53, Doughty Street, John Street, W.C.1. Registered office: 75a, Sancroft Street, Lambeth, S.E.11.

Stonehills, Ltd. (218,281).—Private company. Registered December 17th. Capital, £2,000 in £1 shares. Objects: To carry on the business of manufacturers, importers and exporters of and dealers in electrical sweepers, vacuum and other cleaners, washing machines, smoothing irons, fires, cookers, bulbs and globes and all kinds of electrical fittings and appliances, motor-cars, coaches and accessories, taxi-cab proprietors, charabanc proprietors, &c. The first directors are:—J. F. Stonehill (permanent), 9, Easedale Road, Bolton; Mrs. Mary J. Stonehill, 9, Easedale Road, Bolton. Qualification, £100 shares. Solicitor: A. Lawson, 11, Wood Street, Bolton.

Wessex Power Producers, Ltd. (218,245).—Private company. Registered December 16th. Capital, £12,500 in £1 shares. The objects are: To investigate, undertake, develop, promote or assist, technically, financially or otherwise, propositions or schemes for the generation or production of electricity for power, lighting, heating, traction or otherwise in Great Britain or elsewhere, &c. The first directors are:—H. W. Couzens, 9, Old Queen Street, Westminster, S.W.1, engineer; F. M. Rogers, 8, Avonmore Mansions, Avonmore Road, Kensington, W.14, company director; Sir James Lyne Devonshire, K.B.E.; Sir Philip Dawson, Kt., M.I.C.E.; Lt.-Col. George I. Phillips, C.B.E.; G. C. Hans Hamilton; J. H. Edwards; and W. May. Qualification, 1 share. Remuneration as fixed by the company. Secretary: A. Winterbottom. Registered office: 18, Austin Friars, E.C.2

Radvaco, Ltd. (218,106).—Private company. Registered December 10th. Capital, £200 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in electrical and wireless goods and accessories, electrical and radio engineers, &c., and to adopt an agreement with Blitz Brothers. The first directors are:—M. Blitz, 3, Lynton Road, Acton, W.3, wireless accessory dealer; S. Blitz, 71, Loftus Road, Shepherd's Bush, W.12, wireless accessory dealer. Secretary: C. F. Clover. Solicitor: G. B. Gush, 66, Rochester Row, Westminster, S.W.1. Registered office: 3, Lynton Road, Acton, W.

Insulators, Ltd. (218,191).—Private company. Registered December 15th. Capital, £5,000 in £1 shares. Objects: To carry on the business of manufacturers, exporters and importers of and dealers in all kinds of insulators and non-conductors, whether for electrical, thermal, subaquatic or any other purposes, &c. The permanent directors are:—C. L. Arnold, 34, Abbey Road, Bush Hill Park, Enfield, Middlesex; C. R. Belling, 10, Glebe Avenue, Enfield, Middlesex. Qualification, £50 shares. Remuneration as fixed by the company.

Apex Sun-Ray, Ltd. (218,114).—Private company. Registered December 11th. Capital, £2,000 in £1 shares. Objects: To act as selling agents of Sun-Ray treatment machines, with attachments and appliances for same, &c. The directors are:—C. L. Mendoza, 119-125, Finsbury Pavement, E.C., merchant;; J. Lecker, 53, Hillway, Holly Lodge, Highgate, N.6, merchant; C. Lynes, Bridge View, St. Mary's Road, Long Ditton, Surrey, merchant. Qualification, £10 shares. Remuneration as fixed by the Board. Registered office: Room No. 10, 4th Floor, Balfour House, 119-125, Finsbury Pavement, E.C.2.

Merton Blake & Co., Ltd. (218,234).—Private company. Registered December 16th. Capital, £100 in £1 shares. Objects: To carry on the business of electrical, mechanical, consulting and general engineers, export, import, and general merchants, &c. The subscribers (each with one share) are:—G. H. Olley, 11, Queen Victoria Street, E.C., solicitor; H. Cooper, 177, Walm Lane, N.W., managing clerk. The first directors are to be appointed by the subscribers. Qualification, 1 share. Solicitors: George H. Olley & Co., 11, Queen Victoria Street, E.C. Registered office: 11, Warwick Street, Regent Street, W.1.

Bishop Transmission Co., Ltd. (218,135).—Private company. Registered December 11th. Capital, £100 in £1 shares. Objects:—To carry on the business of motor electricians, ignition specialists, makers and repairers of magnetos, manufacturers of motor-cars, cycles, omnibuses, aeroplanes, and all kinds of vehicles for transport. The first directors are:—R. Bishop, 145, The Vale, Hendon, N.W.11, engineer; J. C. Woodall, "Kinara," West Side, Reigate, London manager of motor company; R. Pentony, 33, Vicarage Road, Hampton Wick, engineer; R. H. Johnson, "The Towers," Hart Hill, Luton (director of Car Corporation of Great Britain, Ltd.). Secretary: J. J. Hawkins. Registered office: Kingsbury House, King Street, St. James's, S.W.1.

Sadia, Ltd. (218,082).—Private company. Registered December 9th. Capital, £2,000 in £1 shares. Objects:—To acquire the business, benefit of all contracts, engagements, rights, privileges, and licences subsisting in relation to the business carried on as "Sadia," and to carry on the business of manufacturers of, and dealers in electrical apparatus, appliances and boilers, thermo regulators, automatic time switches and all kinds of mechanical appliances, &c. The permanent directors are:—L. P. Haussauer, 60, Glenthorne Avenue, Croydon, electrical engineer; A. F. Clemence, 17, Walpole Road, Surbiton (director of Carley and Clemence, Ltd., watch manufacturers). Qualification, £100. Solicitors: W. H. Watson & Co., 10, Old Jewry Chambers, E.C.2. Registered office: 30, Ely Place, E.C.1.

Bolton United Supplies, Ltd. (218,115).—Private company. Registered December 11th. Capital, £100 in £1 shares. Objects:—To carry on the business of wholesale and retail dealers in, and importers, exporters, and manufacturers of electrical and wireless goods, appliances, lamps, valves, &c. The first directors are:—R. E. Morley (managing director), 14, Foxham Street, Great Lever, Bolton; N. C. Jessop, 38, Moorland Grove, Bolton; H. S. Howcroft, 18, Huxley Street, Bolton. Qualification, 10 shares. Registered office: Short Street, Bolton.

Official Returns of Electrical Companies.

Shoreham and District Electric Lighting and Power Co., Ltd.—Mortgage dated December 9th, supplemental to debenture dated March 19th, 1926, further securing £10,000 secured by the debenture, charged on certain leasehold lands and premises at Shoreham-by-Sea, Lancing, and Shoreham Beach. Holders: H.M. Treasury Solicitor.

W. R. Harding & Co., Ltd.—H. J. Herbert, of 40-42, Oxford Street, W.1, ceased to act as receiver or manager on November 20th, 1926.

Simms Motor Units, Ltd.—Satisfaction in full on November 29th, 1926, of Land Registry charge dated April 29th, 1920, securing a current account.

Electracts, Ltd.—Debenture dated November 25th, 1926, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. R. Hind, 24, Priory Mansions, Drayton Gardens, W.8.

Cooper & Smith, Ltd.—A. F. Lovell, of 4, South Street, Finsbury, E.C.2, ceased to act as receiver or manager on December 3rd, 1926.

Pleno, Ltd.—F. E. Bendall, of 26, Corporation Street, Birmingham, was appointed receiver and manager on December 3rd, 1926, under powers contained in debentures dated March 2nd, 1923.

Bradwell Electric Wire and Engineering Co., Ltd.—Debenture dated November 30th, 1926, to secure £450, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. C. Braden, Greenham Cottage, Perry Hill, Worplesdon.

Alpha Electric and Oxy-Acetylene Welding Co., Ltd.—F. Reed, of Westgate Chambers, Newport, Mon., accountant, was appointed receiver on December 6th, 1926, under powers contained in debenture dated December 3rd, 1923.

Mickelwright, Ltd.—Particulars filed of £1,500 debentures authorised December 7th, 1926, charged on the company's undertaking and property, present and future, including uncalled capital, being a specific charge on the company's freehold land and factory, the whole amount being now issued.

Calcutta Electric Supply Corporation, Ltd.—Satisfaction to the extent of £590,000 (being amount issued) on or before November 23rd, 1926, of trust deeds dated November 17th, 1920, and May 22nd, 1922, securing £702,500 first mortgage debentures.

Perak River Hydro-Electric Power Co., Ltd.—A trust deed dated November 30th, 1926, to secure £1,250,000 guaranteed debenture stock, constituting a specific first mortgage and charge on the concession granted by the Government of Perak, dated November 5th, and all licences, easements, rights and advantages thereunder, lands and real and immovable property, present and future, in the Federated Malay States or elsewhere, and all fixed plant and machinery thereon, and a first floating charge on the company's undertaking and property, present and future, including uncalled capital, and ranking in priority to the charge created by the trust deed dated November 12th, securing £1,350,000 7 per cent. participating debenture stock, has been registered by the Perak River Hydro-Electric Power Co., Ltd. The trustees are: Whitehall Trust, Ltd., 24, Old Broad Street, E.C.2.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

W. T. Henley's Telegraph Works Co., Ltd.

An extraordinary meeting was held on December 17th for the purpose of considering an alteration to the company's memorandum of association. Sir George Sutton, Bt. (chairman), who presided, first said that Mr. A. E. Salmon, the secretary, had been appointed to the board while his assistant, Mr. A. H. M. Jacob, had been appointed secretary. Dealing with the resolution before the meeting, he said that the company was still working under a memorandum drawn up 46 years ago, and it was desired to bring it up-to-date in line with other companies. For instance, the existing memorandum did not refer specifically to electric lighting and power cables, and the word "telephone" did not appear at all. The alterations to Clause 3, dealing with the objects of the company, were set out in a printed circular which was in the hands of the shareholders, and he did not think it necessary to read this. Sir George proceeded as follows:—

"The meeting no doubt expects me to make some comment upon the statements which have appeared in the financial columns of the newspapers in regard to possible combination between this company and others, and it is natural for the shareholders to suppose that this alteration of the memorandum of association, which it is proposed to make, is to enable such a combination to be carried through. The board of the company does not require additional powers in the memorandum to enable it to enter into an amalgamation with other concerns. The old memorandum of association gives it all the powers that it would want for an operation of that kind, but the new memorandum also gives it powers to make other arrangements with its competitors. I wish you to know that we have no proposals under consideration for an amalgamation of this business with others. Conversations have taken place between ourselves and some of the cable manufacturers, having for their object the possibility of lowering the cost of production, and of putting the English companies in a better position to secure export trade. It does appear to us that the principal advantage to be obtained from an arrangement with our competitors would be the reduction of our costs of production, the consequent increase of our turnover, which again promotes further reduction of our costs, and the lowering of prices to our customers for our products. Every effort, we feel, should be made to reduce the prices of electrical appliances, so that the demand, which should be universal, and which at present is not, may be helped at any rate so far as the cable side of electrical demands are concerned. The shareholders are aware, from the directors' reports made to them at their recent annual meetings, of the growth of the number of cable factories overseas, and we are bound to consider what sort of competition we shall have to meet with in the near future. In regard to the labour costs in the manufacture of cables, the British manufacturers have been able in recent years to reduce costs by improving output, and that has been done without lowering labour rates, which are at least 40 per cent. higher than those of our competitors on the Continent. Our overhead charges are always rising, and it is here where considerable economies might be made. This company, for instance, spends a large sum of money annually in research. We have very fine research laboratories and a competent staff at our Gravesend works, and similar investigations to those we are making are no doubt being made at the various research departments of some of our competitors. Moreover, we have not the same opportunity of getting efficient results of investigations as we should have with a combination of the ability which is at the disposal of each individual laboratory. There are many other directions in which very considerable economies might be made, which I need not particularly define, as such economies will be very evident to you. I repeat that no arrangement has been made between this company and any others for an amalgamation, and I wish to emphasise that it is not in contemplation to change the individual position of this company, or to interfere with healthy competition. We are trying to eliminate wasteful expenditure for the benefit of all concerned, ourselves, our customers, and of the country's trade."

The resolution was carried.

British Columbia Electric Railway Co., Ltd.

This company's report was reviewed in our last issue (p. 1006). The annual meeting was held on December 16th, when Mr. J. Davidson (deputy-chairman), who presided, called upon Mr. G. Kidd, who has been in charge of the company's affairs in British Columbia for the past 12 years, to present the report. Mr. Kidd said that the province and the company continued to progress, and he dealt at some length with the services rendered by the company to the public of British Columbia. During the past year their output of electricity was 389,418,400 kWh, supplied to 89,270 consumers; they produced 891,504,100 cu. ft. of gas, which they sold to 33,158 customers; and they had carried 72,547,267 passengers and hauled 417,000 tons of freight over their transportation system. In addition, they were gradually acquiring a number of motor coaches and lorries, which acted very largely as feeders to their railway system. All those activities were in the hands of a very capable and courteous staff. It was proposed to set aside a sum of £40,000 to form the nucleus of a pension fund. They had already assisted the staff by means of loans for the purchase of houses and by a comprehensive life assurance scheme. Those provisions and the company's policy of reducing rates whenever circumstances warranted it, had secured for the company the fullest measure of public confidence. Closer relations with the public had been developed by means of a special issue of stock confined to residents of the province. The original amount was largely oversubscribed, and the company, to prevent disappointment, accepted offers amounting to $5,000,000 from 10,523 applicants. The company constantly had to study future developments to be in a position to meet all demands. At the present rate of increase the capacity of their hydro-electric system would have to be doubled every eight or ten years. In conclusion, Mr. Kidd said that it had been stated that Canada was not a good field for investment. There had certainly been failures, but in every case there was a good reason, such as insufficient preliminary investigation, inflated capital, or mismanagement.

The report and accounts were adopted, and, in reply to questions, the chairman said that although it was not intended to make any further issue of capital at present, it was desirable to have a substantial balance of authorised capital available.

Subsequently a resolution was passed increasing the authorised capital to £5,320,000 by the creation of 320,000 new shares of £1 each. A further resolution was passed to give the board greater facilities with regard to the issue of securities by subsidiaries.

City of London Electric Lighting Co., Ltd.

The annual meeting was held on December 15th, Mr. J. B. Braithwaite (chairman) presiding. In commencing his speech, the chairman referred to the death of Sir David L. Salomons, who had been a director for many years. Dealing with the report (which was reviewed in our last issue, p. 1005), Mr. Braithwaite said that the comparatively small increase in the revenue was due to their policy of giving the consumers the benefits of reductions in charges. Although the amount of energy sold had risen by 6¼ million kWh, the cost of fuel had fallen by over £22,000; that justified in a clear manner the directors' policy of keeping the plant up to date. He claimed that no power station in the country generated electricity more cheaply. Referring to the pooling of the resources of the Eastern group of London companies, he said that they had anticipated that development years ago, and they had thus gone a long way in the direction which the authorities desired. The company had made an issue of £220,000 of 5 per cent. consolidated debenture stock, and about half of the second debenture stock had already been offered in exchange for it. He characterised the Electricity (Supply) Bill as a mystery Bill, and questioned the necessity for it. The public had been led to think that the industry was at a standstill, whereas there had been an increase of 51.3 per cent. in the sales of electricity since 1922, and during the past year the Electricity Commissioners had sanctioned the installation of 585,700 kW of additional plant, and loans to the amount of £9,683,301. He deeply regretted the measure, for he considered that the new Central Electricity Board would be a further obstruction to progress, and would result in the raising of the cost of electricity to consumers and checking the development of the industry. The report and accounts were adopted, and subsequently a resolution was passed altering the articles of association to enable the directors to capitalise the reserves. Mr. Braithwaite pointed out that it was wrong to call the distribution of those reserves a bonus; they would not increase the actual dividend received by a single penny.

Bogota Telephone Co., Ltd. The annual meeting was held on December 14th. Mr. H. Kahn (chairman) presided, and in presenting the report and accounts (ELEC. REV., December 10th, p. 967) pointed out that the company had no debentures or other charges, and its total liabilities, apart from the share capital, were under £4,000. The company was steadily progressing; in 1919 the number of subscribers connected was 1,721, and it had risen at October last to 5,270. The company had a long waiting list, and as the capacity of the existing plant was practically exhausted, orders had been placed for equipment to meet the present and future demands. Those extensions naturally involved further capital outlay, and it was therefore proposed to increase the authorised capital from £150,000 to £300,000. The new capital would be issued as and when required, the existing shareholders being given preference. After referring to the continued growth of Colombia and its capital, the chairman said that he thought that the time had come when the company should be allowed to increase its rate of charge, which was the same as existed in 1902. They had representatives in Bogota who would present the company's case to the authorities in an able manner.

The report and accounts were adopted, and resolutions were passed increasing the directors' remuneration and authorising the increasing of the capital.

Dorman, Long and Co., Ltd. In his speech at the annual meeting last week, the Chairman (Sir Arthur Dorman, Bt.) dealt with the disastrous consequences of the coal dispute, among which was a loss of £178,962 on the company's trading for the year, which necessitated the passing of the 6 per cent. cumulative preference dividend. He concluded his remarks, however, by saying that the company had a full order book, and for the first time for many years would be able to work at full capacity, which should lead to an improvement in the position. In the more distant future, too, prospects appeared favourable.

The managing director (Mr. Arthur Dorman) dealt with the European steel agreement, and said that it was in the interests of all concerned that this country should have a voice in the matter. During the last few years there had been a lack of confidence in the industry due to the ever-changing price level. Under the agreement, some stability might be reached.

Atlas Light and Power Co., Ltd. An extraordinary meeting of this company (formerly the Argentine Light and Power Co., Ltd.) was held on December 16th. Sir George A. Touche, Bt., who presided, said that the meeting had been called to approve a conditional agreement between the company and the United Electric Tramways of Montevideo for a consolidation of interests. The proposed arrangements would give the company ownership of electric lighting, power and tramway systems in Cordoba; an electric lighting, power and tramway business in Santa Fé; and the combined electric traction systems of Montevideo. The profits of the last had been steadily progressing, and the company hoped to give the public an even more efficient service and to improve the position of the ordinary shareholders. The agreement was approved, and further resolutions were passed providing for the raising of the capital to £5,500,000 and the alteration of the articles of association. These resolutions were confirmed at subsequent meetings of the debenture holders and preference shareholders.

United Electric Tramways of Montevideo, Ltd.—On December 17th, at an extraordinary meeting, resolutions were passed approving the provisional agreement with the Atlas Light & Power Co.; adopting new articles of association rendered necessary by the extension of the company's business as a holding company; changing the title to "The Sphere Investment Trust, Ltd."; and dividing the £5 preference and ordinary shares into shares of £1 denomination. At a following meeting the holders of the company's first debenture stock agreed to exchange their holdings for the Atlas Company's 5 per cent. debenture stock.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159:—

Burma Electric Supply Co.—20,000 ordinary shares of £1 each, fully paid, Nos. 100,001 to 120,000.

Charing Cross Electricity Supply Co.—460,800 ordinary shares of £1 each, fully paid, Nos. 576,001 to 1,036,800.

Electrolytic Zinc Company of Australasia.—750,000 ordinary shares of £1 each, fully paid, Nos. 1 to 750,000.

Fife Tramway, Light and Power Co.—£300,000 5½ per cent. five-year registered notes.

County of London Electric Supply.—1,773,334 new ordinary shares of £1 each, fully paid, Nos. 1,330,001 to 1,500,000 and 5,000,001 to 6,603,334.

South London Electric Supply Corporation.—234,000 new ordinary shares of £1 each, fully paid, Nos. 310,001 to 544,000.

South Metropolitan Electric Light and Power.—250,000 ordinary shares of £1 each, fully paid, Nos. 1 to 150,000 and 400,001 to 500,000; 350,000 new ordinary shares of £1 each, fully paid, Nos. 500,001 to 850,000.

Thornycroft (John I.) & Co.—2,000 cumulative preference shares of £1 each, fully paid, Nos. 438,001 to 440,000.

The "Sidro" Concern.—A meeting of the Société Internationale d'Energie Hydro-Electrique was to be held in Brussels on Wednesday last. The object was to consider resolutions for increasing the capital from 162,500,000 Belgian francs to 200,000,000 fr. by the issue of preference and ordinary shares of 250 fr. each. Part of the issue is for the purpose of acquiring a holding in the Barcelona Traction, Light and Power Co. from the International Holdings and Investment Co.

Amalgamated Wireless (Australasia), Ltd.—There was a profit of £19,051 for the year ended June 30th last, but against this was set a loss of £6,855 from the working of the coastal stations taken over from the Federal Government, leaving £12,196. This reduced the debit balance brought forward to £4,187. The net profit was more than double that of the preceding year. It is hoped to have the beam stations for communication with England and North America completed at an early date.

British Mannesmann Tube Co., Ltd.—The adverse balance for the past year, after meeting debenture interest, &c., is £77,046. This is added to a debit balance of £278,034, making £355,080, which is carried forward. The report states that a working arrangement with the Mannesmann Co., of Dusseldorf, has been arrived at; this, it is hoped, will lead to the adoption of improved production methods.

Power-Gas Corporation, Ltd.—The accounts for the year ended September 30th last show a profit of £6,232, and to this is added £19,599 brought forward, making £25,831. £1,222 is transferred to reserve, and a dividend at the rate of 4 per cent. per annum is recommended, leaving £12,624 to be carried forward.

Eastern Telegraph Co., Ltd.—The directors have declared a dividend at the rate of 3½ per cent. per annum on the preference stock for the quarter ending December 31st, 1926, and a third quarterly interim dividend of 2½ per cent. on the ordinary stock, free of tax.

Anglo-Argentine Tramways Co., Ltd.—Dividends of 2s. 9d. per share on the 5½ per cent. cumulative first preference shares and of 3s. per share on the 6 per cent. cumulative second preference shares have been declared in respect of the six months ending December 30th.

American Loan for Italy.—The Genoa correspondent of the *Financial Times* is informed that the Terni Electric Company has concluded negotiations for the issue of a $5,000,000 loan in New York.

Marconi's Wireless Telegraph Co., Ltd.—The directors announce that a half-year's dividend on the 7 per-cent. cumulative preference shares will be paid on January 1st, in respect of the half-year ending December 31st.

London Electric Supply Corporation, Ltd.—The directors propose to capitalise £199,800 of the reserves and distribute this in the form of £1 ordinary shares in the proportion of two new shares to each five held.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The directors have declared an interim dividend for the three months ended September 30th of 5s. per share, free of tax.

Barcelona Traction, Light and Power Co.—A dividend of 1¾ per cent. has been declared on the 7 per cent. non-cumulative participating preference shares.

Shawinigan Water and Power Co.—A dividend of $2 per common share has been declared in respect of the quarter ending December 31st.

Northern Mexico Power and Development Co.—Dividends of 1¾ per cent. on the preference stock and 1 per cent. on the common stock have been declared.

Lisbon Electric Tramways, Ltd.—A dividend has been declared on the 6 per cent. cumulative preference shares for the year ending December 31st.

Manila Electric Corporation.—A dividend of 50 cents per share has been declared on the common stock in respect of the quarter ending December 31st.

Great Northern Telegraph Co. (of Denmark).—An interim dividend of 2½ per cent. has been declared.

Howard & Bullough, Ltd.—The directors have declared a quarterly dividend of 6d. per share.

Stocks and Shares.

MONDAY EVENING.

EXCITEMENT of a quiet order has characterised the section of the industrial market in which cable construction shares are negotiated. The big rises last week in Henleys and Callenders formed a stimulus to buyers of Siemens, British Insulated, Enfields, and a few others of the same group. Rumour industriously wove amalgamation chat around well-known names. Sir George Sutton, at a meeting of Henley's proprietors, convened to alter certain of the company's articles, poured polite cold water upon such talk, but said that "conversations" had taken place with other companies, with the object of lowering production costs, and of putting the English companies into a better position to secure export trade.

Callenders, Henleys, Johnson & Phillips, Enfields and Siemens are all about 1/16th up. General Electrics have

strengthened to 31s. India Rubbers are easier at 21s. 3d. The market buoyancy became emphasised by the announcement that a large interest in the British Columbia Telephone Company has been purchased by the Associated Telephone and Telegraph Company (ELECTRICAL REVIEW, December 17th, p. 995). Various well-known undertakings are associated in the purchase, including the International Automatic Telephone, British Insulated Cables, Siemens, and others. The sum of three million pounds sterling is said to be involved, and the development of automatic telephony in Vancouver, and other parts of British Columbia, should provide useful orders to the companies which figure in this important acquisition.

Johnson & Phillips shares are good on account of the contract received by the firm for electrification of a further 78 miles of the Southern Railway. The shares at the present price of 60s. afford a yield of £5 16s. 8d. per cent. on the money, taking the last-paid dividend of 17½ per cent. as the basis of calculation.

In the London Electricity Supply group, prices are easier where movements have occurred. City of London dropped 5s. upon declaration, at last week's meeting, of a bonus issue, from capitalised reserves, that will give one new share for two shares now held. The price afterwards recovered 3s. of the loss, and at 43s. 9d. is 2s. lower on the week. County of London gave way to 3½, the bonus of 4 new shares in respect of 3 old shares failing to meet expectation. South Londons have shed 3/16ths; the distribution in this case is to be 9 new for 10 old, and the South Metropolitan—the other London member of the County trio—will give 7 new for 5 old shares. The South London result is held to be a distinct disappointment. London Electrics lost 1s., the declaration—penultimate in the complete series—being two bonus shares for five of the present shares. The first pair of companies to present their proposals were the Kensington and the St. James's, whose figures were so satisfactory that they caused rises in market quotations and public anticipations. The latter have not been realised by the subsequent announcements. A little table may be useful for references by those who wish to see how comparisons work out:—

Company.	Old shares.	New (bonus).
Brompton	5	1
Charing Cross	5	4
Chelsea	5	3
City of London	2	1
County of London	3	4
Kensington	5	9
London	5	2
Metropolitan	2	1
St. James	5	11
South London	10	9
South Metropolitan	5	7
Westminster	3	2

It is important to notice that the new flat rate of dividend, 7 per cent., will not come into force until the beginning of 1932. In the case of the Chelsea Company, the date will be five years later.

London Power 5 per cent. debenture stock, recently offered at 95, has been in demand, and the price advanced to 1 per cent. premium. The stock is still obtainable free of stamp and fee, but the first interest payment, due in April, 1927, will be for three months only. Dealings have begun actively in Burma Electric ordinary shares, upon which last year's dividend was 8 per cent. The price is 21s. 6d. middle.

The Electric Light & Power Contracts Finance Corporation, Ltd., has been dealt with previously in the ELECTRICAL REVIEW. We have received within the last few days a prospectus offering preference shares and notes of the company. Neither issue deserves the financial support of investors who pay regard to the security of their capital.

Eastern Telegraph ordinary stock has gone back a couple of points to 178½; Eastern Extensions remain at 18. Both companies have declared their regular quarterly dividends of 2½ per cent. actual, tax free. Westerns are easier at 17½. In some directions, a demand has arisen for stocks and shares in companies that pay dividends free of tax, in consequence of the impression that income-tax will be raised in the next Budget. Cuba Submarines have gone back 5s.; United River Plates at 7⅞ are 1/16th up. In the wireless group Marconis are flat at 13s. 9d. The report upon the company's financial condition may be expected about January 4th. Canadian Marconis have gone back to 3s. 7½d.

Home Railway stocks have declined in most cases, Undergrounds reacting with the rest. In the Colonial and foreign stocks, British Columbia issues continue on the up grade. The final dividend on the preferred makes 6¼ per cent., tax free, for the year. Anglo-Argentine preferences regained the slight falls of last week. Brazilian Tractions, after very jerky movements, are 1½ better at 108½. Mexican Utilities continue to sag.

Babcock & Wilcox lost a few pence at 52s. 6d., the iron, steel and allied shares being under the influence of the disastrous Armstrong showing mentioned here (ELECTRICAL REVIEW, page 1007) last week. This has disturbed a confidence that was already none too strong, and prices of shares are heavy. The rubber share market is also somewhat dull, by reason of the uncertain outlook for the produce in the near future. Business in most of the Stock Exchange markets is on a par with the quietude that usually characterises conditions in Christmas week.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1924.	Dividend. 1925.	Price Dec. 20 1926.	Rise or fall.	Yield p.c.
Bournemouth and Poole	£1	14	14	60/6	—	4 12 7
Brompton Ordinary	£1	10	10	1½	—	6 13 4
Charing Cross Ordinary	£1	15	15	2"/-xr	—	6 12 0
do. do. 4½ Pref.	£1	4½	4½	17/6	—	5 2 10
Chelsea	£1	12	12	25/-	—	5 12 0
City of London	£1	15	15	43 9	—2/-	... ...
do. do. 6% Pref.	£1	6	6	23/-	—	5 4 4
Clyde Valley	£1	8	8	28/-	—	5 14 4
County of London	£1	15	15	3½	—⅛	... ...
do. do. 6% Pref.	£1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	£1	7	8	26/9	—	5 19 8
do. 7% Pref.	£1	6	7	23/-	—	6 1 9
Elec. Supply Corporation	£1	10	10	30/6	—	6 11 2
Kensington Ordinary	£1	15	15	24/-	—	5 16 8
Lancs. Light and Power	£1	7½	7½	24/-	—6d.	6 2 5
London Electric	£1	10	10	34/-	—1/-	5 17 8
do. do. 6% Pref.	£5	6	6	5⅝	—	5 11 7
Metropolitan	£1	11	11	30/6	—	5 11 4
do. 4½% Pref.	£1	4½	4½	17/6	—	5 2 10
Midland Counties	£1	5½	6	21/-	—	5 14 3
Newcastle-on-Tyne Ordinary	£1	7	7	21/3	—	6 11 9
do. 5% Pref.	£1	5	5	17/6	—	5 14 3
do. 7% Pref.	£1	7	7	24/-	—	5 16 8
Notting Hill 6% Pref.	£10	6	6	10	—	6 0 0
North Met. Elec. 6% Pref.	£1	6	6	22/-	—	5 9 1
St. James' and Pall Mall	£5	17½	17½	24/-	—	5 16 8
South London	£1	15	15	2⅛	—⅛	6 8 0
South Metropolitan Pref.	£1	7	7	1⅛	—	6 3 0
Urban Ordinary	£1	4	7	1⅛	—	5 17 11
do. 6 % Pref.	£1	6	6	20/6	—	5 17 1
Westminster Ordinary	£1	15	15	24/6	—6d.	5 14 3
Whitehall Elec. Invst. 7½ % Pref.	£1	7½	7½	20/3	—3d.	7 8 2
Yorkshire Elec.	£1	8	8	27/-	—	5 18 6

HOME RAILS.

Central London Ord. Assented	Stock	4	4	69	—	5 15 11
Metropolitan	,,	5	5	63	—½	7 18 8
do. District	,,	8½	8½	66½	—	6 4 0
Underground Electric	£1	Nil	Nil	12	—6d.	Nil
do. do. Income	Bonds	6	6	102	—	*5 17 6

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	101	—	5 18 10
do. Def.	,,	1½	1½	25	—	6 0 0
Automatic Telephone	£1	3	10	2½	—	8 14 4
Chili Telephone	£5	5	6	6⅞	—	4 7 4
Cuba Sub. Ord.	£10	5	5	6⅞	—¼	7 5 6
Eastern Extension	£10	10	10	18	—	*5 11 4
Eastern Tel. Ord.	Stock	10	10	17½	—2	*5 12 1
Globe Tel. and T. Ord.	£10	10	10	18½xd	—	*5 8 1
do. do. Pref.	£10	6	6	11xd	—	5 9 1
Great Northern Tel.	£10	22	20	27	—	7 8 2
Indo-European	£5	9½	10	47½	—	*5 5 10
Marconi	£1	10	Nil	1½	—¼	... ...
Marconi-Marine	£1	10	7½	14	—	6 13 4
Oriental Telephone Ord.	£1	12	12	2⅞	—	*4 18 4
United R. Plate Tel.	£5	8	8	7⅞	+⅛	*5 2 3
Western Telegraph	£10	10	10	17½ xd	—¼	*5 16 0

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref.	£5	5½	5½	2⅞	+⅛	9 11 4
do. do. 2nd Pref.	£5	6	6	2½	+⅛	10 13 4
do. do. 5% Deb.	Stock	5	5	65½	—	7 12 8
British Electric Traction Ord.	,,	7	8	144½	—	5 10 9
do. do. 6% Pref.	,,	6	6	109	—	5 10 1
Brazil Traction	£80	4	5	108½	+1½	4 12 2
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	87½	+1	5 14 5
do. do. Preferred	,,	9/6	136/9	118½	+1	*5 6 0
do. do. Deferred	,,	129/5	8	146½	—	*5 9 3
do. do. Deb.	,,	4½	4½	78½	+1	5 8 3
London & Sub. Trac. 5% Pref.	£1	2½	Nil	6 6	—	Nil
London United Tram. Deb.	Stock	4	4	42½	—	9 8 4
Mexico Trams, 5% Bonds	—	5	5	62½	—	8 0 0
Mexican Light Common	£100	Nil	Nil	31½	—1	Nil
do. Pref.	£100	Nil	Nil	70½	—	Nil
do. 1st Bonds	—	5	5	64½	—	7 15 0
Yorkshire (West Riding)	£1	5	—	12/6	—	... ...

MANUFACTURING COMPANIES.

Babcock & Wilcox	£1	12	13	52/6	—6d.	4 19 1
British Aluminium Ord.	£1	5	10	44/-	—	4 3 4
British Elec. Transformer Pref.	£1	Nil	7	18/3	—	7 13 5
British Insulated Ord.	£1	15	15	67/6	—	4 9 0
Brush Ord.	£1	10	10	26/3	—	7 12 4
Callenders	£1	15	15	3⅞	+⅛	4 7 2
do. 6½% Pref.	£1	6½	6½	23/9	—	5 9 5
Crompton Ord.	£1	Nil	Nil	10/-	—	... ...
Edison-Swan	4/-	10	10	12/9	—	3 2 7
do. 5% Deb.	Stock	5	5	86	—	5 16 8
Electric Construction	£1	10	10	31/3	—	6 8 0
Enfield Cable Pref.	£1	7½	7½	1½	—	6 6 4
English Electric	£1	5	Nil	15/-	—	... ...
do. do. Pref.	£1	6	6	17/6	—	6 17 2
Gen. Elec. Pref.	£1	6½	6½	23/6	—	5 15 7
do. Ord.	£1	5	7½	31/-	+6d.	4 16 9
Henley	£1	16	20	41xd	+⅛	4 11 6
do. 4½% Pref.	£5	4½	4½	4½	—	5 6 0
India-Rubber	£1	5	5	1⅛xd	—⅛	*4 14 1
Johnson & Phillips	£1	10	17½	3	+⅛	5 16 8
Met.-Vickers Ord.	£1	8	8	23/9	—	6 14 9
do. Pref.	£1	8	8	2⅛	—	6 18 4
Siemens Ord.	£1	7½	7½	1½	+⅛	5 0 0
Telegraph Construction	£2	20	10	20½	—	*4 1 4

*Dividends paid free of Income Tax.

Exports and Imports of Electrical Goods and Machinery in November, 1926.

THE progress of our electrical exports continued during November, and although the increase in the total was only £40,379, as compared with the preceding month, it was eleven times that amount when placed against the total of November, 1925. Thus, for the completed portion of the year there has been a rise of well over half a million pounds as compared with the first eleven months of 1925, in spite of the industrial upheaval of the past seven months. Turning to the individual items, we see that the most important rise occurred in the case of telegraph and telephone instruments and apparatus, but there were several other appreciable increases. The greatest fall was in another part of the telegraph and telephone section, *viz.*, non-submarine wires and cables, which decreased by £46,522. The comparison with November, 1925, shows a general increase, only two falls being recorded, *i.e.*, in glow lamps and arc lamps. There were very substantial rises in exports of "other" motors and generators, telegraph and telephone instruments, insulated wires and cables, and unenumerated electrical machinery.

The imports section also shows increases in both comparisons. As against the October figures, there were only four decreases, none of them of great moment. The increases were distributed generally, and here again the largest was in the case of telegraph and telephone apparatus. Increases and decreases were fairly evenly balanced in the comparison with November, 1925, the most important change being an increase of £12,000 in glow lamp imports. The figure for the completed portion of the year is still well below that for the first eleven months of 1925.

The comparatively unimportant re-exports section dwindled further, both in comparison with the preceding month and with November, 1925. A large fall in the re-exports of insulated wires and cables was balanced by a rise in unenumerated electrical machinery.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for Nov., 1926.	Inc. or dec. as compared with Oct., 1926.	Inc. or dec. as compared with Nov., 1925.	Electrical imports for Nov., 1926.	Inc. or dec. as compared with Oct., 1926.	Inc. or dec. as compared with Nov., 1925.	Electrical re-exports for Nov., 1926.	Inc. or dec. as compared with Oct., 1926.	Inc. or dec. as compared with Nov., 1925.
Electrical goods and apparatus (unenumerated)	£192,190	− £15,355	+ £31,991	£125,309	+ £16,238	+ £6,132	£6,572	+ £419	− £146
Insulated wires and cables ...	337,546	− 38,522	+ 89,885	57,653	− 4,821	+ 9,861	549	− 2,444	− 24
Glow lamps	60,822	+ 22,226	− 730	45,345	+ 13,232	+ 12,123	1,799	+ 1,357	+ 1,712
Arc lamps and parts	664	- 102	− 499	1,268	− 806	− 769	3	− 32	− 2
Batteries and accumulators ...	94,472	− 10,308	+ 15,991	102,003	+ 7,212	+ 689	422	+ 68	− 87
Meters and instruments ...	36,760	+ 5,284	+ 2,942	19,842	+ 6,585	+ 1,580	359	− 121	− 208
Carbons...	1,706	+ 254	+ 1,277	9,691	+ 1,988	− 4,037	16	− 461	− 103
Electrical Machinery—									
Electrical machinery (unenumerated)	287,834	+ 23,249	+ 64,629	88,008	− 6,367	+ 9,408	7,143	+ 2,420	− 619
Railway and tramway motors	69,787	+ 19,206	+ 25,909	—	—	—			
Other motors and generators...	236,916	+ 17,825	+ 108,665		—	—	—	—	
Switchboards (not telegraph or telephone)	7,643	− 800	+ 1,581	323	+ 323	− 53	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	61,750	− 46,522	+ 7,775	10,793	− 2,738	− 7,165	40	+ 40	− 1,510
Submarine telegraph and telephone cable...	17,050	+ 10,448	+ 16,608	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	320,081	+ 53,322	+ 94,998	65,603	+ 16,309	− 6,141	3,656	− 1,739	+ 216
Totals	£1,725,221	+ £40,379	+£461,022	£525,878	+£47,162	+ £21,630	£20,559	− £493	− £771
			Exports.			Imports.			Re-exports.
Increase and decreases for eleven months of 1926 ...			+ £568,084			− £416,415			− £34,306

Distortion in Broadcast Receivers.

An I.E.E. Discussion at Birmingham.

A PAPER on the above subject was read by Mr. J. A. Cooper, chief engineer of the Birmingham broadcasting station, with demonstrations by Mr. A. C. Chatwin, assistant engineer, at the second meeting of the newly-formed Wireless Section of the South-Midland Centre of the Institution of Electrical Engineers on December 6th. The new section has about 30 members. The meeting was held in the main studio of the B.B.C., where the members were received by Capt. Paterson, assistant station director.

Mr. COOPER said that the first serious source of distortion in the receiver was reaction, which might be brought about intentianally by coupling back the plate circuit to the grid circuit of a preceding detector, or high-frequency valve, so that the impedance of the circuit was reduced and its decrement lessened, thus increasing selectivity by making the circuit resonant to a limited band of frequencies only. It might also be brought about unintentionally by capacitative coupling between the wiring and between the component parts of the valve. Capacitative coupling could be made negligible by careful lay-out, and the modern tendency was to avoid this source of trouble. It was the unintelligent use of reaction that caused most trouble. If reaction was over-applied the tuning would be so sharp that the full value of the side-band frequencies would be lost, and hence only part of the radiated energy would be adequately reproduced. The ideal receiver should give equal resonance to the carrier frequency, plus and minus 5,000 cycles, and "cut off" sharply at those limits. If too much reaction was applied, the impedance of the tuned circuit would be reduced and oscillation would take place, and the current in the circuit which was feeding back would be out of phase with that of the grid circuit of the first valve, causing what was known as frequency distortion.

The detector, whether crystal or valve, was probably the weakest link in the chain. For perfect reproduction the characteristic of the detector should be a straight line with a sharp bend at the bottom. Some crystals were very good, but none was perfect, and so there must be some slight distortion when crystal sets were used. The valve could be made a better detector. The shape of its anode-current grid-voltage characteristic could be made to have almost any slope, and thus by careful design a valve could be made which would work on that part of its curve which was straight, or nearly straight. Two methods of valve detection were available: anode-bend and cumulative-grid rectification. The former introduced less distortion because the valve was worked on the best part of its curve, and, incidentally, took no energy from the oscillatory system; unfortunately, in this method the amplification of the valve was less than its maximum, and signals were correspondingly weaker than with cumulative-grid rectification. The latter might cause sensible distortion, and perhaps the easiest way of understanding this was to

think of the electron flow. The electrons flowed on to the detector-valve grid; at a given impulse, and before they had all had time to leak off *via* the grid-leak, more electrons came on to the grid. There was thus a time lag, and the voltage of the grid-current could not vary as the transmitter impulses. The less the resistance of the leak, of course, the better the detection, but reducing the leak value also reduced the signal strength, and so many people were led to introduce deliberate distortion into their receivers because they attempted to produce loud-speaker strength with few valves.

Turning to the low-frequency amplifier, the lecturer said more distortion was caused thereby, apart from that which might be due to reaction, than by any other part of the set. To avoid it, the right valves should be used with the correct plate and filament voltages, and the grids should be so biassed that the valves worked always on the straight portions of their characteristic curves. They must never work on either bend, and grid current must never be allowed to flow; if either thing happened linearity was lost and distortion crept in. As the amplification increased, the grid-voltage changes became greater and the sweep of the characteristic lengthened; therefore, it was essential to use valves suitable for each stage of amplification. With regard to the relative impedances of loud-speaker and valve, the magnet windings of the speaker were limited mechanically by the fact that they must not occupy too much space, and electrically by the fact that they must have a small self-capacity or the higher frequencies would be by-passed and not reproduced. Those factors determined the impedance of the loud-speaker; a useful practical rule was that the impedance of the valve should be three times the impedance of the speaker at 1,000 cycles.

Considering the various forms of inter-valve coupling, Mr. COOPER said resistance coupling was usually considered to introduce the least distortion, because the voltage drop across the anode resistance was independent of frequency. It must be remembered, however, that to prevent the high-voltage battery affecting the l.f. valve grids, a condenser must be introduced in the grid circuit. This condenser passed the high-frequency impulses better than the low ones for its impedance, so that the higher the frequency the less the impedance. Choke coupling was becoming popular because it needed less h.p. voltage. In transformer coupling the primary might act as an l.f. choke and by-pass the lower frequencies, while the self-capacity of the windings might also complicate matters. Transformer designers had realised that their products were fruitful sources of distortion, and, by careful designing, transformers were now being made with negligible self-capacity and high primary impedance. From the published curves, however, it might be seen that the amplification below 500 cycles was still generally unsatisfactory. It should be noted that the iron core was also a source of distortion, but that could be reduced to a very small quantity if the iron was permeable and was used unsparingly. Headphones were another section in which it still remained for the manufacturers to achieve perfection. Distortion was introduced by the diaphragms favouring certain frequencies, and headphones also had what was known as "cavity resonance" which resulted in a form of distortion called "sound persistence." A good loud-speaker usually had a better diaphragm than was the case with headphones, but designers still had much to learn. For faithful reproduction account had to be taken of inertia, sound radiation, rigidity of the diaphragm, and the inter-action of sound waves.

In replying to the critical discussion which followed, Mr. COOPER paid a tribute to the Post Office engineers in connection with the telephone lines allotted to the B.B.C. for use in simultaneous broadcasting, and mentioned an important improvement in s.b. work by which the engineers hoped to minimise line distortion and line noises. In the earlier days, he said, it was found necessary to introduce filter circuits at the end of the line, but they were now dispensed with, and the new method, details of which he was not at liberty to disclose, consisted of the insertion at stated and convenient intervals along the line of what were called "mirror images." They revealed the characteristics of the line, and it was possible by their use to check distortion in sections of the line; the ultimate result was that at the station end of the line a fairly good frequency characteristic was obtained. The B.B.C., he added, was at great pains to minimise distortion in its transmitters. In the laboratories were special note oscillators, by means of which every section of the transmitter equipment, from the microphone to the output, could be tested for distortion. The characteristic-frequency curve of the output of the transmitter of the Birmingham station was virtually straight from 50 to 10,000 cycles, which covered the main range of fundamental sound frequencies. He knew of no method of low-frequency amplification in receiving sets which would reproduce with the same degree of linearity over the frequency range other than that of resistance capacity coupling.

The demonstrations by Mr. A. C. Chatwin were made with a five-valve resistance-coupled receiver in conjunction with a cone loud-speaker.

At the conclusion of the meeting, Dr. J. D. MORGAN (chairman) proposed, and Colonel J. F. LISTER (vice-chairman) endorsed, a cordial vote of thanks to Messrs. Cooper and Chatwin and Capt. Paterson.

The hon. secretary of the new Section is Mr. A. T. Thurman, electricity supply station, Soho Road, Birmingham.

Occluded Gas in Very-High-Voltage Cables.*

Some Experimental Results Obtained in the Pirelli Laboratories in Italy.

By ING. LUIGI EMANUELI.

IN previous works we have given prominence to the importance of gaseous films disseminated in the dielectric of a cable, and to the fact that an increase in the working temperature may lead to a relevant increase in the volume of gas contained in the cable. This fact may be easily understood if we consider that the insulating mixture, expanding as a result of the increased temperature, forces the lead tube and increases its diameter, and that in subsequent cooling, with a corresponding contraction of the mixture, the diameter of the lead tube does not diminish owing to the viscous rather than elastic properties of this metal.

The method of determining the quantity of gas imprisoned in a cable, or at least of indicating the effects produced, consists of determining the variation of the power factor in relation to the voltage applied. At an ordinary temperature the dielectric employed in the manufacture of high-voltage cables (paper impregnated with an insulating mixture of mineral oils) for gradients not too high, shows a power factor which is practically independent of the voltage applied. If, however, gaseous films or bubbles are imprisoned in the mass at a certain voltage (which may be called voltage of ionisation) the power factor will be increased by a quantity which, for each value of the voltage, can enable us to calculate the loss of energy in the gaseous films.

Curve *a* (fig. 1) indicates cot ϕ in a three-phase cable of which one conductor is in circuit whilst the remaining two and the lead are earthed. The constant part may be attributed to the dielectric viscosity of the solid portion of the insulator, and the variable part to the gaseous portion; the second part represents the history of the cable. Curve *b* shows the value of cot ϕ of the same cable at the ordinary temperature after it had been heated to 65 deg. C. The very remarkable increase in the portion of cot ϕ due to the gaseous bubbles is easily explained as set out above. Fig. 2 refers to a three-phase cable, and shows the variation with temperature of the difference between cot ϕ at a voltage corresponding to a medium gradient of 4,000 volts per millimetre and that corresponding to 800 volts per millimetre. It is assumed that at the last-mentioned gradient cot ϕ has the same value as at very low voltages. At low temperatures this difference has a very high value: it decreases with increasing temperature by reason of the fact that the mixture, increasing in volume, compresses the gaseous bubbles. The gas, with an increase of pressure, is ionised only at higher voltages and, with equal gradients, shows less loss of energy; the volume of gas, moreover, is reduced by reason of the fact that, to a great extent, the gas forms a solution with the mixture. The loss of energy due to the ionisation of the gas tends, therefore, to fall and the curve of the variations of cot ϕ would (at a given temperature) pass through zero, following the dotted line (fig. 2), but for the intervention of other elements not due to the gas, but to the mixture itself.

We have shown† that nearly all the mineral oils show an almost constant cot ϕ at low temperatures, but that at temperatures above 50 to 60 deg. C. it rapidly increases with the increase of the voltage applied, and at a greater rate the higher the temperature. Thus, in a cable above 50 deg. C. the curve of variation of cot ϕ rises with increase in temperature. The curve representing the variation of cot ϕ, for the reasons above stated, is a V-shaped curve which attains a minimum at about 50 deg. C. The first part, corresponding to temperatures below 50 deg. C., depends almost entirely on the quantity of air disseminated in the cable dielectric, and varies between one cable and another according to the quality of the impregnation. The second part, above 50 deg. C., generally depends only on the kind of mixture and is constant for cables of the same construction. Fig. 3 shows the variation of cot ϕ for various cables having the same kind of insulating mixture, but differing in quality of impregnation.

* Translation of paper submitted to the 1st Congress of the Union Internationale des Producteurs et Distributeurs d'Energie Electrique, Rome, September, 1926.

† L. Emanueli—Conférénce Internationale des Grands Réseaux Electriques, Paris, 1925; paper No. 61.

viz., in the quantity of gas contained in the insulating material. All that has been written so far about cot ϕ refers to the case of a rapid change of the cable temperature; but, if the cable is subjected for a long time to high temperatures, the difference of cot ϕ increases to a value which subsequently remains fairly constant. It would appear that an explanation of this effect is afforded by the fact that, owing to the increase in temperature and to the consequent increase in volume of the mixture, the pressure in the gaseous bubbles increases to such an extent as to cause them to be incorporated almost completely in the mixture. The pressure acting on the lead deforms it by degrees, and consequently diminishes by degrees: the gases thereupon once again free themselves from the mixture. It may be assumed that, after a sufficiently long lapse of time, the pressure will become again little higher than atmospheric, and the volume of free gas will again be very much the same as that of the gas in the dielectric at the original temperature. Fig. 4 indicates the difference between cot ϕ for a cable heated for a short period and for a time sufficiently long to attain the fairly constant condition.

If the above explanation is correct, a cable that has remained for a short time at a high temperature will, when restored to a low temperature, not be as much deteriorated as a cable that has been heated for a long time. This is actually the fact, as shown in fig. 5.

Now, what is the volume of gas which can remain imprisoned in a high-voltage cable of ordinary construction after manufacture? Quite recently an opportunity occurred which placed us in a position to reply to this question during the construction of a cable of the hollow-conductor type filled with fluid-oil.

By applying hydrostatic pressure to one end of a section of this cable, pressure can be transmitted along the central cavity of the conductor to all the points of the cable, and so compress the gaseous films, reducing their volume. It is evident that the quantity of oil required to be introduced into the cable in order to increase the hydrostatic pressure is equal to the reduction in volume of the gas bubbles; once we know the reduction in volume, it is possibly easily to reckon the total volume of gas in the cable at working pressure. It is necessary, of course, to make the necessary corrections so as to take into account the elastic expansion of the lead tube, which is, fortunately, very small.

A first and very interesting result obtained was the proportionality between the volume of gas in the cable and the variation of cot ϕ as indicated in fig. 6; as abscissæ the values of the variations of cot ϕ between the gradients of 4,000 and 800 volts per millimetre are indicated; as ordinates the values of the ratio between the volume of gas and the total volume of the dielectric are shown. The type of cable experimented upon allows of almost perfect impregnation, and the values obtained, though purposely depreciated, are much better than those of ordinary cables. In order to obtain an idea of what occurs in cables of ordinary type it became necessary to extrapolate along the straight line in fig. 6 and to deduce the quantity of gas from the values of the variations of cot ϕ, which are measured in the usual way. Such extrapolation leads one to assume that the volume of gas present in the dielectric of an ordinary cable at a temperature of 20 deg. C. approximates about 5 per thousand to 1.5 per cent. of the total volume of the dielectric; the lower figure corresponds to small cables, the higher one to cables of large diameter.

What happens to the gaseous bubbles disseminated in the cable is not as yet clearly known, and we do not believe a theory exists to enable one to form an exact idea of why the presence of gaseous films results, in many instances, in perforation of the cable. It is even very probable that the occurrence may be the result of more than one single mechanism.

It is a certain fact that the carbonisation of the surfaces between which the gaseous bubbles are imprisoned, in consequence of the energy dissipated in the bubble, has never been ascertained in practice, whilst experiments carried out at high frequency in order to dissipate a larger quantity of energy in the ionised gaseous bubbles, have also given negative results. In an endeavour to clear up this phenomenon, we tried to reproduce it in the following manner.

A small glass bowl A (fig. 7) full of water was placed on a glass plate C, which rested on a metal plate B; the latter and the water contained in the bowl constituted the two plates of a condenser, between which was applied an alternating voltage. Before placing the bowl on the glass plate C, a film of the mixture employed for impregnating high-voltage cables was spread over the plate. The bowl was then placed in position in such a manner as to leave in the centre of

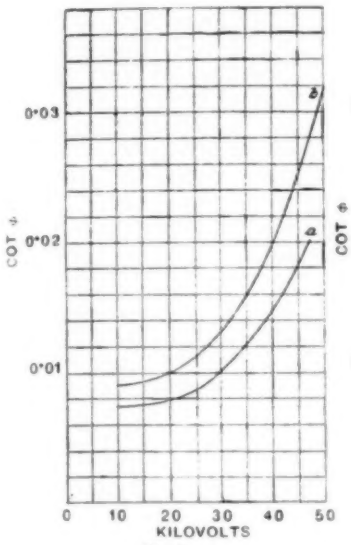


Fig. 1.

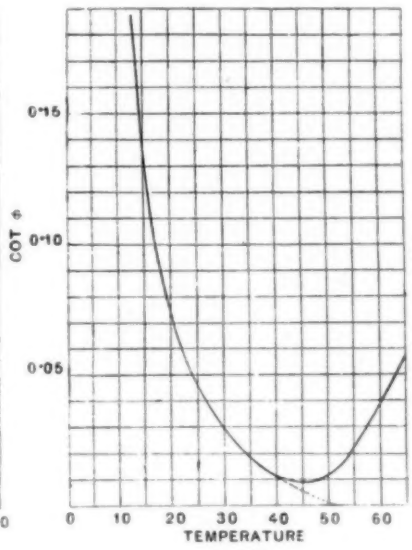
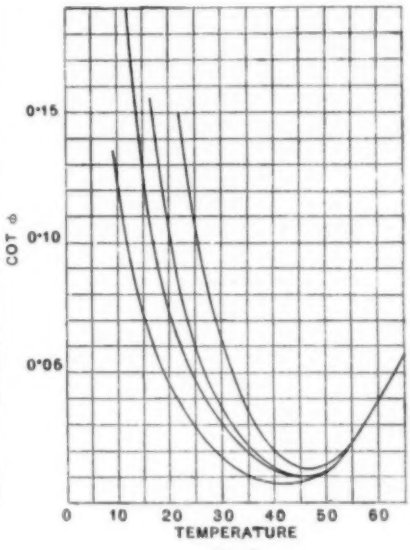


Fig. 2.



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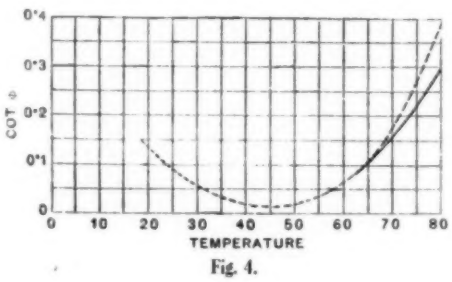

Fig. 4.

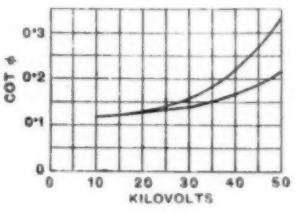

Fig. 5.

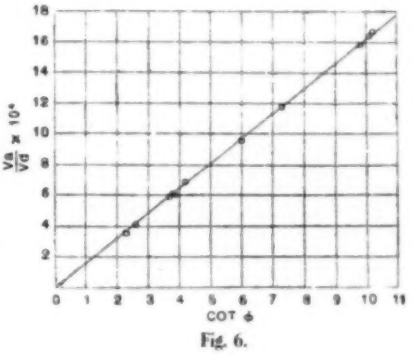

Fig. 6.

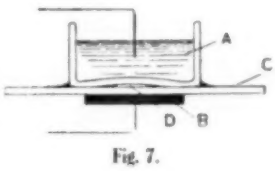

Fig. 7.

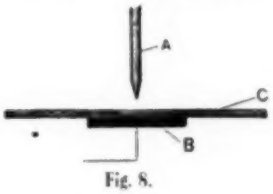

Fig. 8.

contact with the glass an air bubble D (fig. 7). The bubble was easily observable from above through the water contained in the bowl, and could be photographed by transparency, removing at the same time the lower electrode. Fig. 9 is a reproduction of a photograph of a bubble seen in a direction perpendicular to the surface of the water; the bubble was about half a millimetre thick.

By applying a gradually increasing voltage, the bubble is ionised and becomes the seat of well-known luminosities. At a value but little above the value of ionisation, the insulating mixture (constituting the walls between which the bubble

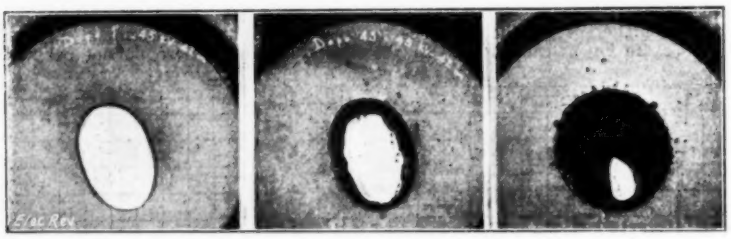

Fig. 9. Fig. 10. Fig. 11.

is contained) is violently shaken, and numerous air bubbles become incorporated with the mixture itself, forming a kind of froth. The phenomenon is clearly visible in fig. 10, taken 45 minutes after the voltage applied had attained the value at which the phenomenon appeared to commence. The less transparent froth in the mixture appears black in the illustration. Fig. 11 was taken after 75 minutes, and fig. 12 after 420 minutes. The bubble has slowly been transformed under the influence of the voltage into a much larger one consisting of an emulsion of minute air bubbles suspended in the insulating mixture.

The transformation of the bubble, which, in the particular experiment just described (owing to the presence of the glass surfaces), could increase its dimensions only in a direction perpendicular to the direction of the electrostatic field, indicated that by using porous material instead of glass, expansion of the air bubble in the direction of the field would also possibly occur; experiment confirmed assumption. The glass plate C (fig. 7) was replaced by a layer consisting of several sheets of paper well dried and impregnated with insulating mixture; great care was taken to avoid the inclusion of gases. Over the layer, covered with a film of insulating mixture, the bowl was placed in such a manner as to leave an air bubble between its bottom and the upper surface of the layer of impregnated sheets of paper. By subsequently applying the voltage, it was demonstrated in an indisputable manner that the air contained in the top bubble passed gradually through the sheets of paper, spreading in the direction of the applied electrostatic field.

The experiment just described appears to furnish the explanation of a previous experiment in the same laboratory; but, instead of being suspended after a short period, it was continued for a long time. It was then seen that on the surface of the layer of paper within the limits of the air bubble a small spot became apparent, just as if at that point the insulating mixture had been projected out of the sheet of paper. After a certain time the point became luminous and from it went off a discharge which branched out in tree-shaped formation over the surface of the bowl. When the voltage was maintained the discharge became more and more luminous, and a second brilliant point could then be seen between the first and second sheets, not far away from the first point and connected with it by tree-shaped discharges. In some instances, after a certain time, luminosity became concentrated at a point which appeared to be still further down, but near the first two; the luminosity and the tree-shaped discharge in the bubble under the bowl increased in intensity, and finally the glass was perforated. On the contrary, when the experiment was suspended immediately after the appearance of luminosity in the vicinity of the small spot, it was found that the sheet of paper was perforated at that spot by a very small hole only visible with a powerful magnifying glass, and showing no mark whatsoever of carbonisation.

A probable explanation of the last-mentioned experiment may be supplied by the results of the preceding ones; that is to say, the air in the bubble is dragged through the sheet of paper, probably only through such points as offer an easier passage in consequence of greater local porosity. The passage is gradually made easier by the fact that the mixture contained between the pores of the paper is dragged by the gaseous molecules; thus, a bubble is formed under the first sheet of paper, and by similar mechanism it is subsequently propagated to the second, the third, &c., sheets.

From what has been stated above, it is evident that the passages through the various sheets of paper may not coincide; as a matter of fact, generally they do not. The air, or rather the current of gaseous ions, that goes through the passage which it has been able to force through the first sheet of paper, finds an obstacle in the second sheet; the air purshes back and emulsifies the mixture all round, forming a film of gas between the first and the second sheets. A point more easily penetrated by the mixture is, so to speak, *sought for* on the second sheet of paper; when found, its mixture is driven away under the bombardment of the gaseous ions and, finally, when the passage has become more practicable, the gas is projected between the second and the third sheets, and so on.

The small holes observed in the sheets of paper are probably due to the breaking down of the barriers set up by the fibres of the paper against the passage of the gaseous ions. If the energy dissipated increases in consequence of extension in the direction of the field, it is possible to generate such heat as will cause the luminous points observed and even carbonisation, which can assume a tree form, such as is very often found in cables near points of perforation. Carbonisation, however, has been reproduced only in some of the experiments made; in all, however, in which the tree-shaped discharge was visible by transparency through the paper, after disconnecting the condenser and carefully separating the various sheets of paper, it was possible to see marks of the discharge on the actual sheets. It appeared as if the discharge grazed the surface of the paper, carrying away the film of mixture adhering to it.

This phenomenon does not appear to be due to heating, but to the dragging of the mixture by the gaseous ions, which idea appears to be proved by the following experiment. An alternating electrostatic field is created between a point A, fig. 8, and a flat electrode B; on B are placed about 10 sheets of paper C impregnated with pasty insulating mixture similar to that used for high-voltage cables. As soon as the voltage is applied, the film of mixture adhering to the surface of the top sheet of paper is projected all round, as if a powerful jet of air issued from the point, and the paper is swept clean of the mixture, which slowly moves from under the point. The mixture is also projected away from the interstices between one fibre and another. Where the efflux emanating from the point is more intense, there the sweeping away of the mixture is likewise more energetic.

It is interesting to notice that if, instead of an alternating field, a constant field obtained by either an electrostatic machine or a rectified current is employed, only a very slight movement of the mixture occurs immediately the voltage is applied; then everything remains still. It is quite probable that the ions projected immediately by the point on to the sheets of paper form thereon superficial discharges which annul the electrostatic field.

The scorching of the impregnated paper under an alternating field has all the appearance of being produced by the bombardment of gaseous ions which, issuing from the point,

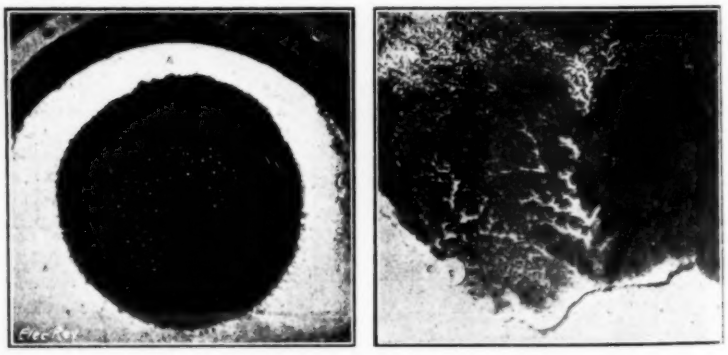

Fig. 12. Fig. 13.

first of all easily displace the mixture on the surface of the sheets all round the point, then little by little penetrate the mass of sheets, choosing the easiest way mechanically, and thus creating canals through which the insulating mixture is replaced by the gas projected from the point; the barriers opposed by the fibres of the paper are forced, or slowly demolished, by the ionic bombardment.

From what has been set out above, the mechanism of the discharge following the presence of gaseous bubbles in the insulation of a cable appears to be due to the bombardment and to the excessive propagation of gaseous ions through the dielectric, following the lines offering the least resistance. This applies to the barriers opposed both by the mixture and by the fibres of the paper; the last-mentioned barrier is, of course, the most resistant one. This would explain the tree-shaped carbonisation and, moreover, make evident the effect of time.

Experience has, furthermore, made it undoubtedly clear

that the phenomena observed are the more conspicuous the greater the dimensions of the gaseous bubbles in the direction of the electric field. A thin film requires a voltage gradient much higher than a thick film in order to give rise to the phenomena of the disturbance of the mixture and the trailing of the gas through the paper. It appears, therefore, from the experiments made, very probable that there exists a critical value of the gradient in relation to the thickness of the bubbles, which probability would explain the fact that all high-voltage cables work perfectly evenly at a higher voltage than that of ionisation.

They appear, furthermore, to furnish an explanation of the fact that single-phase cables behave better than three-phase ones. In the latter it is quite common to have empty spaces of a larger size due to the facts that, the diameter being generally larger, it is easier for creases to form in the insulation due to bends, and that the three cores constituting the cable may undergo mutual sliding, which increases the space between the fillings and the cores. The success of metal-core cables is probably due to the fact that the formation of such empty spaces can no longer be prejudicial along the surface of the paper tapes.

When tangential components intervene they may affect gaseous films between one tape and another, following their maximum dimension, and very easily provoke discharges which extend from layer to layer in tree-like form without being opposed by any barrier; this occurs particularly in joints. Fig. 13 is a reproduction of a photograph of a sheet of paper which formed part of the insulation of a joint. The tree-shaped discharge has not produced any carbonisation, but has extended into the film of mixture existing between one layer and another, displacing it on its way. It is visible simply owing to the fact that along its course the film of mixture has been carried away and the sheet has consequently become more transparent.

Concerning the quality of the insulating mixture employed to impregnate the cable, where it is very viscous, it is difficullt to carry away, and so forms a good rampart against the bombardment by the gaseous ions; when the mixture is very liquid, it is easily carried away, but at the same time it can easily close up the breaches made in its compactness. This fact may furnish an explanation of the better behaviour which fluid oils appear to preserve in cables and joints, as compared with viscous mixtures.

The Electrical Control of Water Levels.

A System for the Remote Indication and Regulation of Liquid Depths.

THE automatic control and remote indication of liquid levels, particularly water, in docks, wells, irrigation plants, mines, storage tanks, and so on, in this country is at present chiefly effected by means of mechanical apparatus involving such appliances as floats and blocks and tackle, which, at the best, are somewhat cumbersome and not altogether reliable. We have recently learnt of a system of electrical control in this connection which should prove of considerable interest to electrical engineers and others concerned with water-control problems. The system, "Aegir," is being introduced in this country by Messrs. Isenthal and Co., Ltd., who have established a demonstration plant at their Acton works, and the following notes on its construction and operation may prove useful.

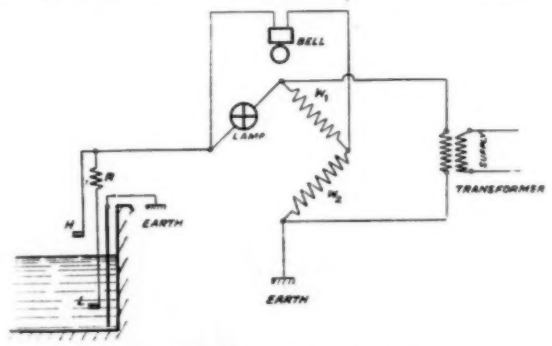

Fig. 1.—Wheatstone-Bridge Control Principle.

The principle of the "Aegir" system is based upon the variation of the resistance of an electric circuit at one particular point, the variation being brought about by the extent of immersion of a specially constructed high-resistance rod, the transmitter, suspended in the liquid, the depth of which has to be determined. It is, of course, necessary to employ a.c., in order to prevent electrolytic action, and as the operating circuit is necessarily earthed, either a transformer or a small motor-generator is essential for the source of supply. The indicating instrument is a special milliamperemeter, calibrated so as to give the desired measurements, and may take the form of an ordinary dial or recording instrument. A number of indicators may be used with the transmitter, or it is possible, by means of suitable switching, to employ one indicating instrument in conjunction with several transmitters.

The indicators may also be combined with electric contact devices to control acoustic and visible signals for giving warning when low- or high-water level is reached. In this case the Wheatstone-bridge principle is employed in the circuit, the signal device being connected across the "balance" points, fig. 1.

The indicator is arranged on a switchboard, fig. 2, which also accommodates the necessary cut-outs, switches and indicating instruments.

The transmitter proper, fig. 3, consists of a suitably graded resistance rod constructed of a combination of short resistance units of different specific conductivities. It is supported by means of insulators on an earthed galvanised-metal tube, forming one pole of the circuit. It is claimed that the resistance material of the transmitter is unaffected by the liquid, even if this is of an acid nature. The length of the water path through which the current passes is permanently fixed, the distance between the resistance rod and the support; and the resistance of the liquid—other factors being constant—only varies with the depth of immersion. The rod and support are built up as a complete unit, which is suspended in the well or cistern. A protection sheath may be provided where there is a risk of damage from floating objects or other influences. It is also claimed that the very thin film of moisture which is left on the rod when the liquid sinks is of such a high resistance as not to affect the accuracy of the measurement, the film being found to be non-continuous and really consisting of a large number of minute isolated globules

Fig. 2.—Indicating Apparatus.

Fig. 3.—Level Transmitter.

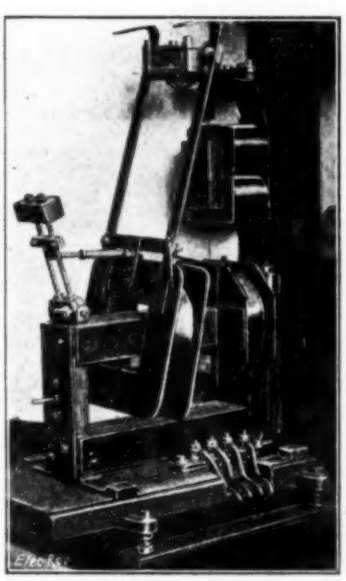

Fig. 4.—Pressure-Regulating Transformer.

which do not offer any path to the current. This phenomenon is due to the nature of the resistance rod, and particularly to its surface. Further, the instrument is unaffected by temperature changes, and the liquid round the rod will not freeze owing to the passage of the current from the rod.

The connection between the transmitter and the indicator is by means of a single 16 s.w.g. wire, or a cable of similar capacity. It is essential, of course, for accuracy of indication, that the current in the resistance circuit should be at a constant pressure, and any fluctuation in the supply pressure is compensated for by means of an ingenious transformer device. The main supply is carried by the fixed primary winding of a special transformer, fig. 4, the secondary of which is movable about the common core so that its distance from the primary winding may be varied. A rise or fall of pressure in the primary causes the distance between the two windings to be increased or decreased with the consequent and respective lessening or increase in the flux cutting the secondary turns. The secondary coil is carried on a hinged bracket which provides the necessary connections to the coil. The induced current in the secondary is taken to a second and fixed transformer, which supplies the actual operating circuit.

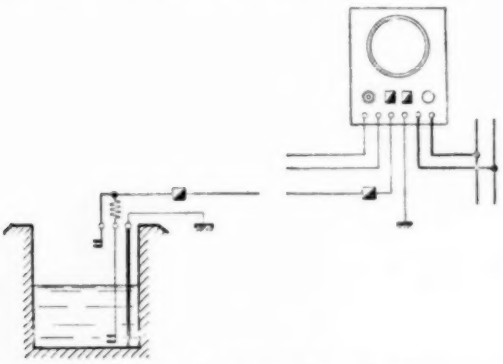

Fig. 5.—"Aegir" System and Pump Control.

The system may also be employed for the remote control of pumps, sluice valves, and so on, the operation of which is necessary at certain levels of the liquid. This should prove of particular advantage for water pumping in mines, where the absence of movable parts, such as floats and chains, would prove of great advantage. Suitable contacts are arranged in the desired positions. Fig. 5 illustrates the working of the system. As soon as the water touches the upper contact an armature in the control equipment is attracted and either opens or closes the starting circuit, according to whether the pump is supposed to fill or empty the tank in which the contacts are placed. This condition persists until the water falls below the lower contact, when the armature will drop and not be attracted again until the high-level contact is immersed. It is claimed that level differences as small as 2 mm. can be dealt with in this way.

The operating device is mounted on a switchboard, fig. 6, and consists of a robust electromagnetic switch with mercury contact tubes, all contained in an instrument case. The core and armature of the switch are made of high-grade transformer iron, and the contact tube is of ample cross section to prevent wear and burning. The distance between the receiver and the switch is practically unlimited, and, as with the level indicator, only one connecting line is needed. Fig. 7 shows the construction of this transmitter.

Where several pumping stations are employed, various combinations can be arranged for, such as switching in a second pump when the first has been unable to keep up the level of the water. Both pumps may be put out of action simultaneously when the water level has risen to a certain height. Moreover, by employing change-over switches different

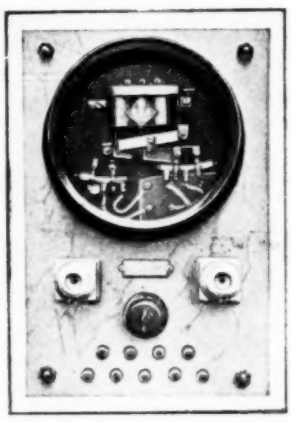

Fig. 6.—Pump Operating Unit.

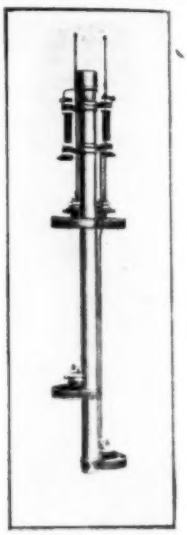

Fig. 7.—Pump-Control Transmitter.

pumping stations may be actuated. By the insertion of a suitable push button it is possible, without interfering with the normal sequence of operations, to start or stop the motor at any desired moment.

A further application of the system lies in the measurement of gas pressure in mains and other receptacles. In this case the pressure of the gas upon a column of water varies the level of the water in one limb of a container, thus varying the extent of immersion and hence the circuit resistance, a small and similar resistance unit being inserted in the limb or tube.

A French 60,000-Volt Distribution System.

Some Notes on the Underground Network of the Union d'Electricité in the Paris District.

By Colonel E. MERCIER.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper describes the 60,000-volt underground cable distribution network which has been successfully operated since April, 1922, in the Paris district by the Union d'Electricité.

The network is at present supplied by the new steam-driven station at Gennevilliers (capacity 360,000 kVA), and the old steam-driven station at Vitry, which has been completely modernised (present capacity 80,000 kVA). These two stations will shortly be connected to the hydro-electric station which is under construction at Eguzon on the River Creuse and in which 40,000 kW of plant is being installed.

The network forms a ring round the city of Paris (fig. 1), and has been designed with a view to supplying at a limited number of points power ranging from 15,000 to 50,000 kVA. The power stations being at distances of something like 30 km. from the feeding points, it was necessary to adopt high-voltage transmission; but on account of the Paris suburban districts through which the transmission lines pass being entirely built over, the use of overhead lines was out of the question, so that the power company had to adopt the highest voltage possible with underground cables. The voltage chosen was 60,000 V, the frequency being 50 cycles, only adopted after very careful laboratory researches extending over a period of two years. The network at present comprises 220 km. of three-phase feeders (equivalent to 660 km. of single cables) and more than 2,500 junction boxes. In winter, nearly 2 million kWh are transmitted daily under conditions which are now quite satisfactory from the point of view of reliability.

Choice of Single Cables.—At the time when it was decided to lay the first feeders, three-core cables with equipotential surfaces were not available. After a series of tests, three-core cables were abandoned because they did not provide a sufficient margin of safety, or an adequate overload capacity. The reasons were as follows:—

(*a*) The electric field in a three-core cable being rotary, at certain instants the electric lines of force are tangential or parallel to the layers of the paper insulation, and it can be conceived that the lengths of their paths through any bubbles of air which may be occluded between the layers of paper may be sufficient to affect appreciably the electric strength. Moreover, the construction of three-core cables, no matter how carefully carried out, always involves a heterogeneous region from which it is impossible to remove all air and which becomes a partial conductor when the air is ionised. In the above respect single cables are much to be preferred; for, in place of the rotating field, we have a radial alternating field at right angles to the layers of paper. If an attempt were made to design a 60,000-volt, three-core cable having a potential gradient less than the critical gradient for ionisation (*i.e.*, about 3,700 volts per mm.), the size would be prohibitive.

(*b*) Again, if the problem be examined from the point of view of temperature-rise, the conclusion will be that the ordinary three-core cable is decidedly inferior to single cables of the same cross-section. The heat produced in the copper conductors of a three-core cable cannot be dissipated towards the centre and, consequently, only a small part of the surface of each conductor is effective for conducting the heat away. Experience has shown that this method of considering the problem is correct and that the current-carrying capacity of a 60,000-volt, three-core cable is much too low to justify its use in practice.

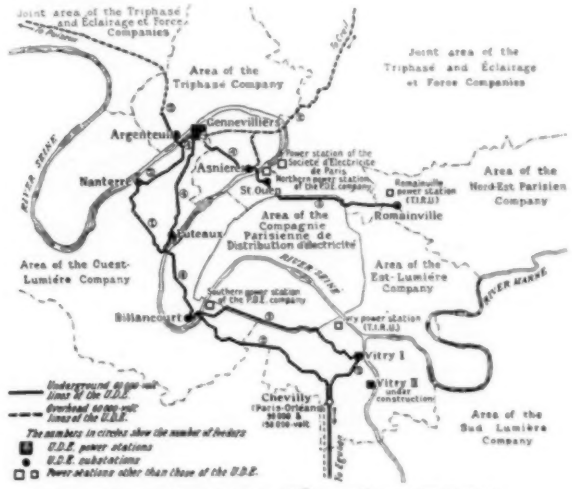
Joint area of the Triphasé and Eclairage et Force Companies
Area of the Triphasé Company
Joint area of the Triphasé and Éclairage et Force Companies
Gennevilliers
Argenteuil
Asnières
Nanterre
St Ouen
Area of the Nord-Est Parisien Company
Romainville
Area of the Compagnie Parisienne de Distribution d'électricité
Puteaux
Area of the Ouest-Lumière Company
Area of the Est-Lumière Company
Billancourt
Vitry I
Vitry II under construction
Chevilly
Area of the Sud Lumière Company
RIVER SEINE
RIVER MARNE
Underground, 60,000-volt lines of the U.D.E.
Overhead, 60,000-volt lines of the U.D.E.
The numbers in circles show the number of feeders
U.D.E. power stations
U.D.E. substations
Power stations other than those of the U.D.E.

Fig. 1.—Route Map of Union d'Électricité's 60,000-V Cables.

The principal dimensions of the single cables employed are as follows:—Sectional area of copper conductor=150 mm²; thickness of dielectric=14 mm.; and of lead sheath=2.5 mm. This cable cannot be protected by an iron tape, as the energy losses in the armouring would be excessive. The cable was made in 250-metre lengths, and the maximum potential gradient of the dielectric is about 4,250 volts per mm. at the normal voltage.

In addition to the dielectric and I^2R copper losses, there are energy losses in the lead sheath of two kinds: (1) Eddy currents induced circumferentially by the magnetic field of the cable; the resistance of the circuit in which these currents flow does not exceed 1 microhm per km. length of cable. (2) Circulating currents which are induced by the magnetic field set up by the current in the conductor, which flows to earth at each junction box. In order to reduce appreciably the circulating currents it is necessary to decrease the resultant magnetic field in the three conductors and, for this purpose, to bring all the cables as close together as possible. The three single cables comprising a feeder should therefore be arranged at the corners of an equilateral triangle. Tests show that the increase in the line losses due to eddy currents and circulating currents is equivalent to about 10 per cent. of the copper losses, but the loss due to wattless current is decreased in the same proportion.

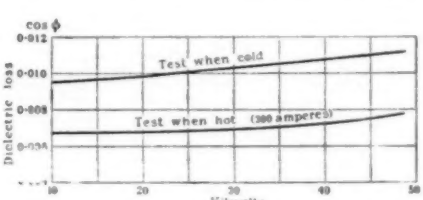

Fig. 2.—Relation between Dielectric Loss and Voltage.

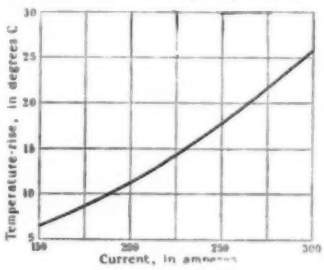

Fig. 3.—Temperature Rise as Function of Current.

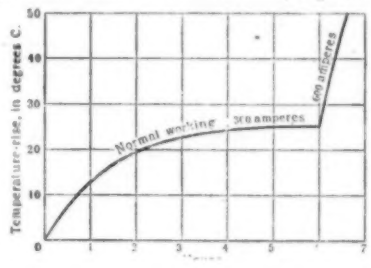

Fig. 4.—Heating Curve of Single Cable.

Fig. 3 shows that with 300 amperes, *i.e.*, a current density of 2 amperes per mm.², the temperature-rise does not reach 26 deg. C., so that even if it is assumed that the temperature of the soil may be as high as 18 deg. C., the temperature of the cable will not reach 45 deg. C. It would also appear that the temperature of the dielectric of these cables does not exceed 50 deg. C. in these conditions. We may therefore regard 300 amperes as the normal rating of these cables, so that their carrying capacity is 31,000 kVA. Assuming the temperature of the soil to be 10 deg. C., a cable having a normal carrying capacity of 300 amperes can carry 600 amperes for 15 minutes without exceeding 50 deg. C. (fig. 4).

Junction Boxes.—The junction boxes must be non-magnetic; lead has been chosen. Each box is soldered to the sheath of each cable entering it, thus ensuring not only complete watertightness but also continuity of the lead. They are filled with compound in the ordinary way, but their dimensions are such that the potential gradient across the dielectric is lower than that required for ionisation. Each box is earthed to a copper tube 50 mm. in diameter and 1 metre in length driven into the soil. In practice the boxes have been found to be the least reliable part of the circuit; although breakdowns in the cables themselves have been completely eliminated, the same cannot be said of the junction boxes. The number of breakdowns is really very small in comparison with the number of junction boxes installed, but the company has nevertheless been experimenting for some time with a new type of box in which the joint is insulated with impregnated paper, the compound serving merely as a mechanical protection (fig. 5). These boxes have not been in use sufficiently long to enable a definite opinion to be formed of their reliability. The terminal box is of the ordinary type.

Testing of Cables.—Before any cable is laid, the following pressure tests are carried out at the maker's works:—(1) Twice the working pressure, *i.e.*, 70,000 volts, between the copper conductor and the lead, for 1 hour. (2) Three times the working pressure, *i.e.*, approximately 110,000 volts, for 5 minutes.

Cable Laying.—The cables are placed in U-shaped reinforced-concrete troughs and automatically arrange themselves so that the lines joining their centres form an equilateral triangle; they are covered with sand in order to dissipate the heat more effectively. When laying cable manually, it is necessary, in order to prevent damage, to take care that it is subjected to a steady pull. In awkward positions, the cable is suspended from a steel carrier cable which is pulled by means of a winch. Round a very sharp bend, the radius of curvature must not be less than 1 metre.

Three-phase Cables with Equipotential Surfaces.—As an experiment, the Union d'Électricité is at present laying a few lengths of 60,000-volt three-core cable of a new type. It consists of three insulated cores, over which is wrapped a layer of metallic paper which constitutes an electrostatic screen throughout the whole length of the cable. A lead sheath encloses the whole, and is itself protected by iron armouring in the usual way. The cross-section of each conductor is 150 mm.², and the overall diameter of the cable is 108 mm. The metallic paper provides a sufficient path for dissipating the heat generated in the centre of the cable, and the same current densities can be employed as in single cables. It is less liable to injury, and renders it unnecessary to use special troughs; the extra losses due to currents in the lead sheath are completely eliminated.

On the other hand, this type of cable is more expensive than single cables, and junction boxes are cumbersome, expensive, and complicated. The repairing of a fault, which involves the dismantling and rebuilding of two junction boxes, puts the cable out of operation for a considerable time.

Pressure-Rises and Surges.—Several investigations of pressure-rises and surges on the system have been carried out and the results published.* The wave-form of the turbo-alternators at Gennevilliers and Vitry is almost sinusoidal, and any tendency of the harmonics to become serious would be taken care of by the magnetic saturation of the step-up and step-down transformers. Apart from this, investigations have shown that the risk of pressure-rises due to resonance of the harmonics in the wave-forms of the alternators can be entirely disregarded, notwithstanding the very unfavourable conditions which exist in the system. Sudden application of pressure causes a surge which in the most unfavourable case may reach twice the normal pressure, whilst the sudden disconnection of

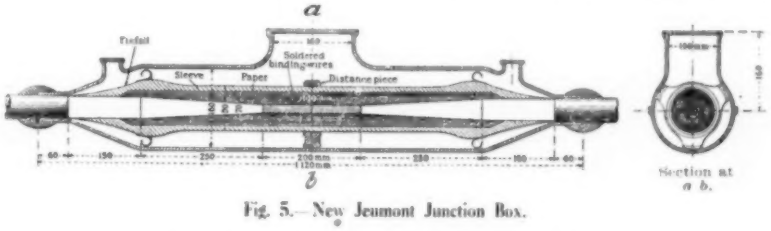

Fig. 5.—New Jeumont Junction Box.

* J. Fallou, paper presented to the International Conference on High-tension Lines, 1925.

a cable may subject it to three times the working pressure. We do not hesitate to carry out these operations when they are essential, but in ordinary working we prefer to increase and decrease the pressure in steps, and for this purpose the Gennevilliers station is provided with a special motor-generator which consists of a synchronised asynchronous motor of 600 h.p. coupled to a 6,000-kVA three-phase generator, and a 6,000-kVA, 6,000/60,000-V step-up transformer. The generator is so designed as to give with perfect stability its maximum power with a leading power factor of $\cos \phi = 0$. Its rotor is provided with a strong amortisseur which enables it to work as a single-phase machine to apply between phases, and between each phase and earth, a single-phase pressure of 70,000 volts.

Conclusion.—Four years' experience enables the Union d'Electricité to state definitely that a network of single cables working at 60,000 volts between phases is quite satisfactory from the point of view of reliability provided that suitable precautions are taken in installing and, especially, in designing the junction boxes. It considers that no advantage would result if in the extension of its network it were to favour three-core cables of any make. In the opinion of the company, single cables involve not only a smaller initial outlay, but also greater reliability and better facilities for effecting repairs; and compared with these advantages such a disadvantage as, for instance, the increase in the losses in the lead sheath, appears to be negligible.

Discussion in London.

In the absence of the author, a *résumé* of the paper was read in English by one of his staff, Mons. J. FALLOU.

Mr. P. V. HUNTER thought the I.E.E. Council's practice of inviting distinguished foreign engineers to contribute to the Institution's proceedings commended itself generally. He congratulated the author on his pioneer work represented by the paper; at the time it was carried out there was no precedent to go by, and if it had to be redone now there would be little to change. The author had also largely consolidated the supply of electricity around Paris. In all systems a point would be reached at which single cables must be used, and their advantages were conceded; but he could not agree with the author's criticisms of 3-core cables. The "heterogeneous region from which it is impossible to remove all air" was not a practical trouble. He would have expected the fig. 3 curve to be a straight line, but the thermal conductivity seemed to decrease with temperature rise; the cables were buried in sand, and as the latter was a good thermal conductor only when damp, the shape of the curve appeared to be due to the sand drying out. Transient heating effects were very different from steady-load heating effects, because in the former case the lead sheath was not heated much and the internal pressure was greater, due to expansion. Too much had been made of single-cable sheath loss, and the Paris case had shown that there was nothing to worry about. The use of a special generator for charging the cables was apparently made necessary by the failure of joints when direct switching was employed, whereas the cables themselves stood it. The joint shown in fig. 5 was supposedly hand wrapped with paper, which operation was attended with much difficulty at the voltage concerned.

Mr. J. S. HIGHFIELD referred to the immense amount of work which the paper represented, and the different views held on the subject showed that the science was still in its infancy. As to the reason for the necessity of employing such high voltages, he emphasised the difficulty of finding sufficient room to accommodate all the cables required to carry away the power generated by, say, a 500,000-kW station; that aspect was likely to become of increasing importance. He would have liked more information on the subject of capacity currents at high voltage; they might be overlooked, but many kW might be absorbed by a line when no load at all was being transmitted, and complicated means might have to be employed to make such a line work at all. If h.p. was essential, then it was necessary to secure the same degree of security of supply as consumers had been accustomed to in the past, otherwise some of the larger consumers would feel insecure.

Mr. C. J. BEAVER thought the paper came at an opportune time; many pernicious statements had been made on the subject. With regard to the author's reasons for choosing single cables, there was a danger of users being "stampeded" into abandoning the 3-core type before the actual necessity to do so arose. The author had shown foresight in his choice, but Mr. Beaver did not agree that the same conditions obtained to-day as then. It was agreed that the trouble was caused by the ionisation of air, but the "heterogeneous" region mentioned was not the source of trouble when the cable was properly made; that point made in the paper had not been confirmed in practice. Altering the assembly or form of a cable did not change its contents or dielectric: the whole thing turned on manufacturing methods—no gas should be occluded. A sheathed single-core cable would be more expensive than a single- or three-core cable. There was nothing to fear from tangential stress if the cable was free from air. The type of joint-box which had given trouble in Paris could probably be improved if the trough section were continued to the ends. Regarding the author's conclusion "that no advantage would result" from the use of "3-core cables of any make," the speaker thought that when Col. Mercier visited England he must have been intercepted in London.

Major A. M. TAYLOR agreed that single-core cables were better than 3-core for voltages above 50,000 V, and also that a distinct step forward had been made with metallic paper sheathing, but the cores should be separately impregnated. The losses found by the author were considerably in excess of those experimentally determined and checked by Prof. W. Cramp, who calculated 1½ per cent. against Col. Mercier's 10 per cent.; the losses decreased at higher voltages. Table I showed that a greater average potential gradient, necessary

TABLE I.

Type of cable.	Thickness of insulation in mm.	Average pot. grad. kV/cm.	Increment in P.F. per 33% increment in voltage (cold).	Voltage of operation.
Col. Mercier's 1-core	14	24·7	5	66,000
"Intersheath" 3-core	10 7·2 6·6	37·8	8·5	156,000
Pirelli's 1-core	18·4	43·7	14·0	132,000
Metallised 3-core	12 appr.	29·0	6	66,000

with very high voltages and great depth of insulation, resulted in ionisation curves having a steeper slope. Therefore it must not be concluded that changing the equipotential surfaces from elliptical to concentric could be relied on to help any further at the very highest voltages, partly on account of the difficulty of impregnation. The only course then available was to reduce the depth of impregnation (at one operation) and it was because the speaker had reduced this to 10 mm. (even though dealing with 150,000 volts) that he got considerably better results than those obtained at a much lower voltage, when the depth of impregnation was greater. A conclusive experiment was made on this point: it was found that by impregnating the two outer cores of the speaker's cable in one operation, *i.e.*, increasing the depth of impregnation to 13 mm., the intermediate core gave a p.f. 33 *per cent. worse* than the outermost core and no less than 100 *per cent. worse* than the *innermost* core. (It ought to have given a figure only about 27 *per cent. worse* than the innermost and 18 *per cent. better* than the outermost.) There was no doubt that by diminishing the average voltage gradient on the two outer cores (by increasing the depth to 10 mm. in each case) still better results could be obtained. The risk of pressure rises due to resonance of the harmonics in the wave-form of the alternators was not worth considering, but transformer harmonics were *not* so negligible. It was *not* the pressure "*rises*," but the continued super-position of 3rd, 5th and 7th harmonic *currents* over and above the normal capacitance currents which had to be watched. The route from Gennevilliers to Vitry was 15 miles in length: at 5 A per mile, this would amount to a superposed capacitance current per feeder of 75 A and might easily pass unnoticed at the generating station, and the pressure rise due to it would also pass unnoticed. Nevertheless, a 5/10-ampere current per mile, at the 5th harmonic might eventually break down the cable insulation. This was a point for the cable makers to settle. The ordinary 5th harmonic current due to partial resonance might be only perhaps 10 A for the whole system, but, when a single generator was running, the whole of this current passed through the secondary of the step-up transformer, and, if it had a lead of nearly 90 deg., it would exert a considerable effect on increasing the deformation of the flux wave of the transformer, and 1 per cent. deformation, on the 5th harmonic, might easily account for the introduction of 2,000 volts into the resonating circuit. As the oscillation contributed initially by the transformer (that which gave the 10 A) was only perhaps 30 volts, the new current might possibly rise to 750 A and might easily amount to 75 amperes per feeder or 5 amperes per feeder per mile.

Mr. N. A. ALLEN contended that the conclusions reached in the paper must not be accepted for conditions in this country. An economic study would alter the case; considering cable made and laid in England, if the total annual costs were compared, the 3-core type laid direct in the ground would prove its superiority.

Mr. C. VERNIER pointed out that the impregnation of very-high-voltage cables was very difficult, but said that patchy impregnation could now be overcome. Laboratory tests designed to indicate the quality of cable were not impressive; if air could be excluded, the formation of spaces after the cable had been laid could not be prevented. He referred to tests carried out on various kinds of cable on the North-East Coast, remarking that the type being tried in Chicago showed promise for high pressures. Concerning the methods of laying 60,000-volt cables, the British practice appeared to be better than that described in the paper. He had not had joint trouble on either 3-core or 6,600-V single cable; great care would be needed in making the type of joint illustrated in fig. 5, and his experience was that jointing practice was far in advance of cable manufacture. There should be no necessity for installing special cable-charging plant; it might be all right in a generating station, but would not be practicable for switching operations in sub-stations.

Mr. T. N. RILEY was surprised at the author specifying pressure tests only; higher and longer tests than those mentioned in the paper had been applied to cables which had nevertheless failed. It could not be maintained that dielectric tests were no criterion of cable quality. Certain

kinds of tests were of value; for instance, power factor curves were obtained immediately after a cable was made. After being heated on load, the impregnating compound expanded, and the lead sheath too, but on subsequent cooling the lead retained its larger diameter, and so voids were formed; they could not have them perfectly impregnated, and cables failed when cooling after having been fully loaded, whereas those which had been lightly loaded only had not failed.

Mr. R. A. BROCKBANK suggested that if the author's cables had not operated at a temperature above 45 deg. C. maximum, then he had not experienced the troubles encountered in this country. Considerations of permanent expansion suggested that cables should be operated at a permanent temperature, which was not a very practical proposition, but it might avoid the formation of voids. When the cable operated at a temperature above 50 deg. C. was the dangerous period, and it should be treated as such. The author's case would have been strengthened if he had tried to armour his cables, and the speaker believed that with the aid of non-magnetic iron, high voltage, and lower current density it would soon become possible to armour such cables.

Mr. P. DUNSHEATH was disappointed with the paper, remarking that it should have been longer and have contained more detail of how, when, and where the cables failed; he, however, agreed that the use of 3-core cable at 66,000 volts was impossible. The value of the paper would be enhanced if an appendix could be added to it containing details of cable and joint-box failures; they all wanted that sort of information. Regarding the reference to the employment of devices (attributed to Mr. Capdeville) for reducing sheath losses, rather than break the lead at intervals, it would be preferable to bond it. In connection with the laying of cables, the author mentioned a minimum bend radius of one metre, which was 44 times the diameter of the cable; therefore, he had apparently found it difficult to train his laying gang.

Mr. G. H. NASH appealed to engineers not to be too dogmatic about this subject; as Mr. Highfield had said, the science was in its infancy. Mr. Dunsheath had surprised him by using the word "impossible," because he (Mr. Nash) thought it was possible to make 66,000-V, 3-core cable. Also his views were quite contrary to some of those expressed by Mr. Beaver.

Mons. J. FALLOU reserved his reply to the discussion for publication in the I.E.E. *Journal*.

Compact Compound-Filled Switchgear.

Some Features of the Metal-clad Equipment made by the British Thomson-Houston Co., Ltd.

THE desirability of high- and extra-high-voltage switchgear being of the utmost compactness, in many cases, is one of the requirements which led to the manufacture of metal-clad compound-filled equipment by the British Thomson-Houston Co., Ltd. In addition to its safety and reliability, it is so designed that it can be operated by semi-skilled labour, and besides simplicity of erection, extension and alteration can be made with a minimum interruption of supply.

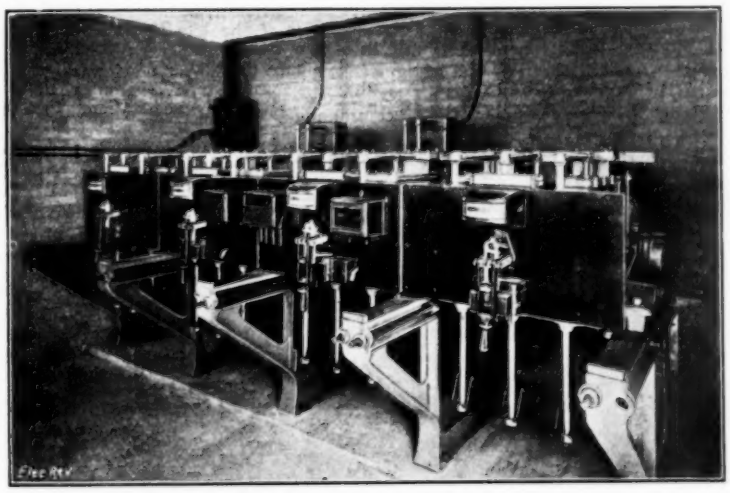

Fig. 1.—Compound-filled Gear in 11,000-V Sub-station.

An example of this type of gear in use in 11,000-volt circuits is shown in fig. 1, and fig. 2 shows an oil-immersed circuit-breaker in the withdrawn position, the tank having been lowered by means of the transporting carriage, which is capable also of removing the complete breaker portion.

Each equipment comprises two portions:—(1) Fixed main frame, bus-bars, circuit chamber, cable box and potential transformer, if required; and (2) a movable oil circuit-breaker arranged to plug into the fixed part. The circuit chamber is mounted above the bus-bar chamber, which arrangement enables a potential transformer to be mounted above the gear in a readily accessible position and permits the renewal of a potential fuse while the equipment is in commission without danger to the operator. The current transformers for metering and tripping purposes are accommodated in the chambers carrying the top plugs, and this arrangement enables a transformer to be changed without breaking cable joints, avoiding the necessity of decompounding any part of the equipment, a feature of considerable importance when the maintenance of service is vital. Shutters automatically cover the live contacts when the breaker is withdrawn, and are so arranged that the busbar and circuit shutters can be separately, or collectively, padlocked.

In the case of duplicate busbars being used the breaker is connected to either set by means of removable self-aligning plugs which are inserted into the upper or lower plugging insulators, or, when desired, oil-immersed selectors can be provided on the fixed portion of the gear, and are operated by handles which are interlocked with the breaker so that it is impossible to break the circuit on the selectors.

The breaker is moved into, or out of, engagement with the bus and circuit contacts by means of screws, on which are mounted travelling blocks to which the breaker is coupled by removable dowel pins; two screws per unit are provided, being coupled by means of a chain and sprocket wheels at the back of the equipment, either screw being available for operation by a detachable handle. When in the fully plugged-in position the wheels of the breaker engage under restraining lugs, which, together with the screw mechanism, prevent the breaker moving when it operates under heavy fault conditions.

The circuit-breaker operating handle is accommodated by a steel panel, on which may be mounted the instruments; the breaker top plate accommodates the operating mechanism and provides an air buffer to restrict the gas pressure when it operates under fault conditions, while pebble-filled separating chambers and gas vents cool the gases and form an intricate baffle to prevent oil-throwing. The breaker contacts are of the finger pattern, reinforced by steel backing springs, fitted with renewable arcing tips. As the mechanism is entirely enclosed, with the exception of the separating chambers and vents, there are no slots through which oil can be thrown; enclosure also has the effect of avoiding any tendency of the

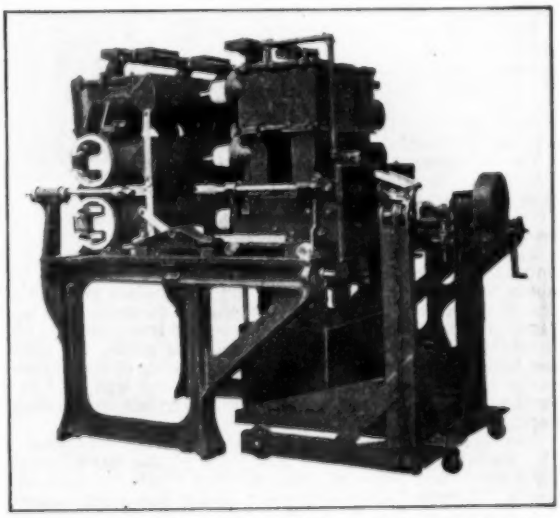

Fig. 2.—B.T.-H. Compound-filled Equipment for Remote Control, showing Breaker withdrawn.

breaker to reclose on a fault due to internal gas pressure. A new form of buffer ensures minimum stresses in stopping the cross-bar at the end of its opening stroke, and is equally effective whether the oil tank be on or off.

The plugging contacts are self-aligning and can be readily replaced without decompounding a unit; interlocks prevent the breaker being inserted, or withdrawn, while it is in the closed position, thereby preventing any danger of breaking the circuit on the plugging contacts. The instrument and control wiring is enclosed in conduit on the movable portion of the equipment, and interconnections between units are carried in easily accessible channel conduit, which accommodates also the auxiliary plug-and-socket contacts for the connections between the fixed and moving portions.

Busbar sectioning and paralleling equipment has been standardised, and a suitable device for earthing the circuit or bus through the oil circuit-breaker can be supplied when required to ensure that if a live circuit be inadvertently put to earth, injury to the operator will be avoided. Such equipment is made in various sizes for use on circuits up to 33,000 volts and with rupturing capacities up to about 1,000,000 kVA. Both single and duplicate busbars are provided for in the designs, and in the latter case selection may be by means of movable plugs, or, alternatively, by oil-immersed selectors so arranged that a circuit may be transferred, when required, from one bus to the other without shutting down.

A Bulk Supply Scheme.

The New Electricity Undertaking at Newark.

ON December 16th an electricity supply to Newark, Notts. was officially inaugurated by the Mayor, Major L. C. B. Appleby, who "switched on" at the supply sub-station. The energy, 3-phase, 50 cycles, is received in bulk from the Derbyshire and Nottinghamshire Power Co. *via* a line from Kirkby-in-Ashfield, a distance of some 24 miles.

The line pressure is 33,000 V between phases as far as Farnsfield, where an outdoor switching station has been erected, and from this point the supply is transmitted at 11,000 V by means of duplicate feeders which terminate in the Newark Corporation's main sub-station.

The sub-station is built on a steel framework, with brick walls, and is arranged in two stories. The upper floor contains the 11,000-V switchgear and metering equipment, and the ground floor accommodates the medium- and low-pressure switchgear, as well as the necessary transformers for reducing the supply pressure to 400 V between phases, 230 V between phase and neutral. Access to the upper floor or e.h.p. gallery is obtained from outside the building.

The switchgear contract was placed with Messrs. Ferguson, Pailin, Ltd., and for the 11,000-V equipment, fig. 2, their "CV"-type, metal-clad, drop-down type is installed. The metering of the Power Co.'s supply is by means of two Hill-Shotter kVA demand indicators, and on for the 11,000-V equipment, fig. 2, their kVA demand indicators are installed.

The low-pressure switchboard is of the non-interlocked, cubicle type; the street-lighting circuits controlled therefrom are equipped with automatic electrically-operated time switches by Messrs. Nathan & Allen, Ltd., which are fitted with astronomical dials.

The transformers were supplied by the British Thomson-Houston Co., Ltd., and each is of 250-kVA capacity at 0.8 p.f. They are oil-immersed, self-cooling, and provided with calcium chloride breathers.

The provision of the mains and other accessories was entrusted to the Macintosh Cable Co., Ltd., which has laid about 25,000 yards of cable. On the distribution network all the disconnecting boxes are above ground to enable easy and rapid disconnection (fig. 1). The cables are four-core, p.i., l.c., armoured, and laid direct. As a jointer's guide, the covering between the lead and the inner armouring of the 11,000-V cables has been heavily impregnated with red lead, and as a further precaution these cables have been laid at a greater depth than the l.p. mains.

The Wardle Engineering Co., Ltd., as a sub-contractor to the Macintosh Co., supplied the whole of the street-lighting equipment, and along the main street through the town this firm's "Barrow"-type suspension fitting has been adopted. An interesting feature is the lighting of the old spacious Market Square. Here a handsome central lamp has been erected, and equipped with three fittings, each containing a 300-W gasfilled lamp, equipped with Holophane clear glass outer globes, with domed refractors. Nearby is a feeder pillar containing the necessary switchgear and meters whereby connection can be made to removable stalls for lighting on market days. The original contract for the supply meters was placed with Messrs. Ferranti, Ltd.

The retail rates fixed are 7d. per kWh for lighting, 3d. for power, and 2½d. (first 50 kWh) and 2d. for heating. Special agreements are entered into for e.h.p. supplies. The bulk-supply charges are to be at 1.25d. per kWh, with a minimum total of £2,000 per annum for the first two years and £3,000 per annum for subsequent years.

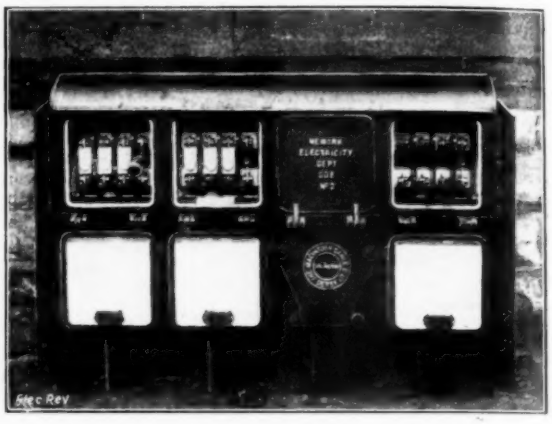

Fig. 1.—Over-ground Disconnecting Box.

Throughout the scheme the object has been to keep down the capital commitments to a minimum without sacrificing efficiency, and there has been no endeavour to elaborate either the sub-station building or any of the apparatus. The consulting electrical engineer responsible for the scheme is Mr. R. W. Willis, M.I.E.E., of Manchester, who was appointed as the successor of the late Mr. C. H. Wordingham on the death of the latter.

At the inaugural ceremony the Mayor of Newark was presented with a gold master key by Mr. Willis, on behalf of the contractors, with which he opened the sub-station. In a short address he wished the scheme every success. After the ceremony the company was entertained at dinner by the Mayor in the Town Hall.

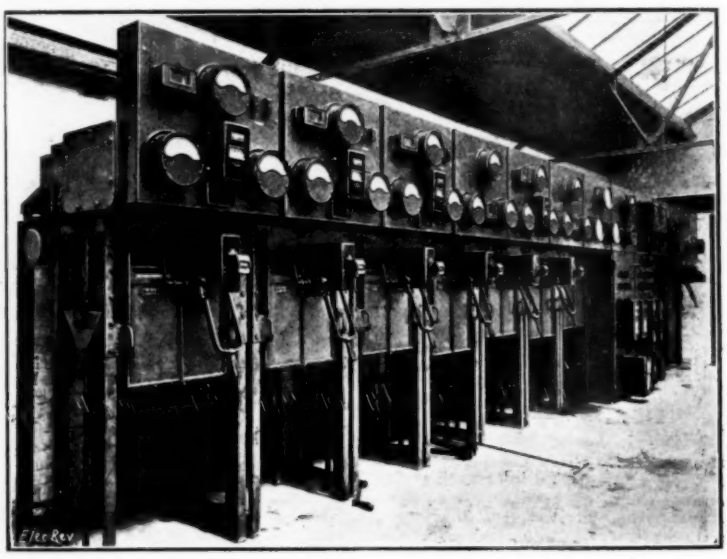

Fig. 2.—Ferguson-Pailin 11,000-V Switchgear at Newark.

In proposing "The Electrical Engineer," his Worship reviewed the history of Newark's efforts to obtain a municipal supply for the past 25 years, and congratulated Mr. Willis on the able way he had carried out the scheme.

Mr. Willis suitably replied and, on behalf of the contractors, presented the Mayor with a solid silver statuette, depicting a figure of Progress holding aloft an electric lamp.

The toast of "Success to the Scheme" was submitted by Ald. H. E. Branston, J.P., and responded to by Mr. A. D. Phillips, manager of the Derbyshire & Nottinghamshire Power Co., and Messrs. C. H. Hampson and D. D. Watson, of the Macintosh Cable Co.

Gift of Lighting Plant to Hospital.—Lady Forbes-Leith, of Fyvie, has presented a complete installation of electric lighting plant to the Fyvie Cottage Hospital, Aberdeenshire.

New Electrical Devices, Fittings and Plant.

(Readers are invited to submit particulars of new or improved devices and apparatus.)

A New D.C. Electricity Meter.

A new electricity meter for the measurement of continuous current has recently been introduced in Germany. The instrument works on the voltameter principle, which is claimed to give the most accurate results in practice, the current consumption being measured by the proportional flow of mercury through a porous wall. Fig. 1 shows diagrammatically the arrangement adopted. In the upper part is inserted a small quantity of mercury A, which gradually passes, with the flow of current, through the porous separating wall P on to the cathode K. The latter is of a special carbon on which the quicksilver will not lie, but falls into the calibrated tube below. The current consumption is, of course, proportional to the height of the thin column of mercury, and is indicated by the surrounding scale. By means of the resistances W and S only about 1/500th of the current to be measured is passed through the meter. When the indicating column becomes full, or when it is desired to reset the meter at zero, the instrument is unlocked and the tube casing slowly inverted. In this way the quicksilver is returned to the anode chamber. It is stated that in the majority of cases it takes from one to two years to fill the column, and it is claimed that the passage of the current has no effect on the liquid solution nor on the electrodes.

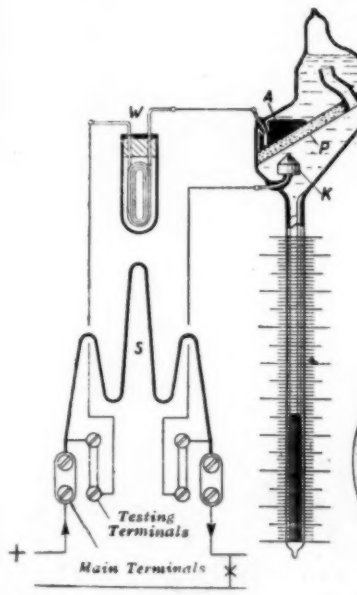

Fig. 1.—A D.C. Meter.

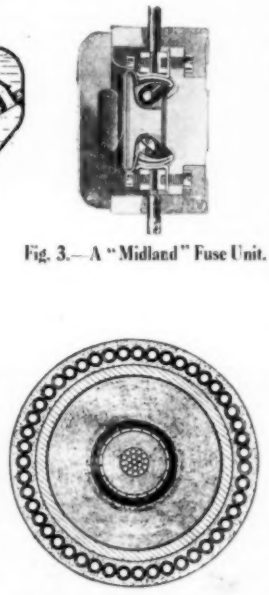

Fig. 2.—A German 110,000-V Cable.

A New 110,000-Volt Cable.

At the recent Industrial Exhibition in Dusseldorf was displayed a new 110,000-V cable which had been made for the Rhenish Westphalian Electricity Supply Co. Fig. 2 shows a section through the cable. The conductor is constructed as follows: a thickness of paper is wound round a copper core, and over this a plaited layer of sectional flat wires is laid. The h.p. current passes through both the central core and the concentric ring of flat wires. The conductor, the total copper cross-sectional area of which is 95 sq. mm., has consequently an artificially enlarged diameter of 0.88 in., so that the potential gradient in the innermost layers may be as low as possible. The insulation comprises three concentric layers of impregnated paper, of varying thicknesses, the innermost layer being the thickest and the outer layer the thinnest. The diameter of the cable under the lead covering is 2.38 in. The cable is armoured with round steel wires, separated by spaces 33 per cent. of their thickness. The transmission losses in the armouring amount to, it is claimed, but 5 per cent., and in the lead covering to only 15 per cent., of the losses in the cable conductor. The external diameter of the cable is 80 mm. (3.14 in.).

An Electric Car Washing Apparatus.

A good example of self-contained electrically-operated plant is the Myers cyclone automobile washer which has been introduced into this country by the B.E.N. PATENTS, LTD., 100, Victoria Street, London, S.W.1. The outfit comprises an electrically-operated, self-oiling, high-pressure pump, an unloading regulator, and two or more 25-ft. lengths of h.p. hose fitted with special power guns. A pressure of 300 lb. per sq. in. is obtainable. The plant should prove of great value in the garage and a saver of time and water.

A Distribution Fuseboard.

We have received from the MIDLAND ELECTRIC MANUFACTURING CO., Birmingham, some particulars of a new small distribution board, which it has produced for loading up to 15 A at 250 V. It is constructed in either teak or iron cases. The teak boards are fitted with solid fronts to avoid the usual unsightly dirty glass and the trouble caused to the contractor by broken glass panels. The ironclad boards are drilled with an ample number of holes for cable entries for both mains and circuits, each hole being stopped with a watertight steel plug which may be removed easily without tools, so that the boards can be carried in stock and sent direct to any job ready for erection. An interesting feature is the new design of fuse unit which is embodied in the board; fig. 3 shows a sectional diagram of this. The curved surfaces of the contacts form a spring grip to ensure against disturbance of the handle by vibration, and at the same time give pressure contact. The fuse wire passes through a tube in the handle, which is dimensioned so as to allow ample ventilation and effectually damp the arc. Fig. 4 shows a 6-way ironclad board.

Fig. 3.—A "Midland" Fuse Unit.

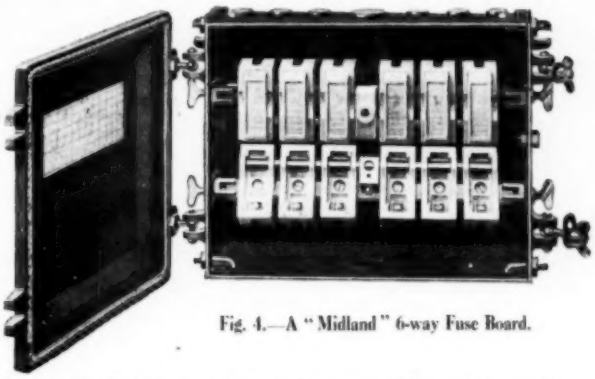

Fig. 4.—A "Midland" 6-way Fuse Board.

An Electric Micrometer.

At the annual Convention of the American Institute of Electrical Engineers this year a paper was read by Mr. A. V. MERSHON, describing a new instrument, the electric micrometer, which has been designed to detect and measure mechanical vibrations in either the stationary or rotating parts of a machine. The principle of the instrument is to use magnetic flux changes to detect the vibrations, and the essential part is a bridge circuit with a test coil and a transformer coil as one arm, and a dummy coil and a duplicate transformer coil as the other. The dummy coil has an iron core with an adjustable air gap, and the test coil has an iron core, the air-gap of which varies with the vibration or motion to be recorded. Any unbalance of the magnetomotive forces produced by the currents in the two transformer windings gives a flux which induces a pressure on a third winding connected directly to an oscillograph vibrator. The instrument is excited by an a.c. of 500 cycles. Fig. 5 illustrates the working.

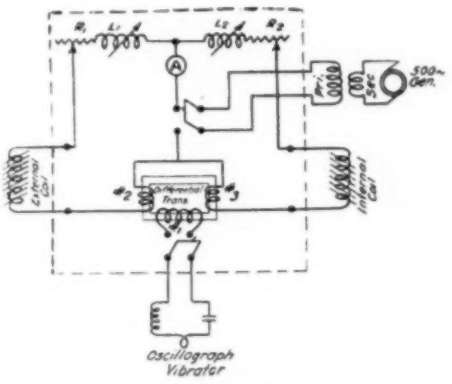

Fig. 5.—An Electric Micrometer.

The voltage of the test coil is balanced against that of the dummy coil by the two opposite windings of the differential transformer, the third winding of which carries the out-of-balance current, and the variations of this are employed to indicate the vibrations, in thousandths of an inch, that take place in the core of the test core. The two branches of the instrument circuit are exact duplicates, and the resistances R_1 and R_2 and the inductances L_1 and L_2 are secondary parts of the circuit for keeping components of the two arms equal. It is claimed that vibrations as small as five- or ten-thousandths of an inch can be measured.

Legal.

Breach of Factory Electrical Regulations.

ON December 13th, at the Uxbridge Police Court, the West End Brickworks, Ltd., Northolt, and David J. Clack, manager, were summoned for breaches of the electrical regulations under the Factories and Workshops Act. It was alleged against them that they omitted to provide adequate safeguards in connection with their electrical installation, and as a result of this neglect the death of an employé (Leonard May) occurred. It appeared that the company's electrician was directed to fit up a temporary installation for testing some pneumatic shovels, and an extension wire was connected to a switch. There was water in the switch, and owing to this a metal pipe became charged. May came into contact with this pipe and was killed, while another man was seriously injured. For the defence it was contended that Regulation 7 left it to the discretion of the person concerned to decide what measures of safety were necessary. The electrician considered that what he did was sufficient, and it would have been but for the fact that the switch was not in order. The Coroner had decided that no blame could be attached to anybody for the fatality.

The Bench found the defendants guilty of breaches of the regulations, and imposed fines and costs amounting to a total of £146. The chairman pointed out that under the Act the whole or any part of the fine could be applied for the benefit of the deceased man's family, at the discretion of the Secretary of State.

The British Broadcasting Co., Ltd., v. The B.B.C. Assurance Association and Britain's Best Crystal, Ltd.

THIS was a dual application for injunctions to restrain the defendants from using the letters "B.B.C.," on the ground that it was an infringement of the plaintiff company's trade mark.

Mr. MORITZ, for the plaintiffs, said that the B.B.C. Assurance Association and Britain's Best Crystal, Ltd., were directed by and principally owned by two persons. The defendants' practice was to sell crystals in boxes and enclose with them a form of insurance policy against damage by fire resulting from wireless installations. They had no connection with the British Broadcasting Co., Ltd. Mr. TREVOR WATSON contended that the injunction should not be granted, as the defendants' business was different from that carried on by the British Broadcasting Co. Moreover, the plaintiffs had accepted advertisements for their *Radio Times*, in which the initials were used.

Mr. Justice TOMLIN said that, although the businesses were different, the defendants could not be allowed to use a name which might suggest that their enterprise was under the ægis of the British Broadcasting Co., Ltd. He therefore granted an injunction, until the trial of the action, restraining the defendants from trading in the name of the B.B.C. Assurance Association or in any other name containing the letters "B.B.C.," or any colourable imitation, without clearly distinguishing themselves from the plaintiff company. The costs of the motion would be costs in the action.

Compensation Awarded Against the British Thomson-Houston Co., Ltd.

AT Halifax County Court, on December 16th, Hetty Carter, widow of Joseph Carter, Sheffield, claimed compensation and costs, before his Honour Judge McCleary, against the British Thomson-Houston Co., Ltd., in respect of the death of her husband on August 24th last, whilst working for the company at the Halifax Corporation electricity works. For the defence, it was stated that Carter was killed whilst doing something in a place against which he had been warned and in which he had no right to be. Mr. P. P. Richardson, turbine-house superintendent at the Halifax electricity works, gave evidence that he had warned Carter against the danger of going to certain cubicles, which were plainly marked. Where the man should have been working there was no danger at all. His Honour Judge McCleary found that Carter had made a legitimate mistake, suffering under a misapprehension. Judgment was entered for the widow for £300 and costs.

Fraud Charge.

AT Leigh, on December 15th, Osmond Gibson Irlam, proceeded against for obtaining £3 15s. by false pretences from Messrs. Lee & Co., wireless and electrical dealers, Market Street, Atherton, was bound over. Defendant was stated to be a traveller in radio goods, and he called on Messrs. Lee & Co. regarding loud speakers. Mr. Collier, a partner, said that defendant promised to obtain some of these if he advanced the money. Prisoner received a cheque for £3 15s., and promised to bring the loud speakers the same day. Later he wrote that he was unable to get the loud speakers, but a letter was produced from a Manchester firm stating that it had an ample supply in stock. The cheque was cashed but no goods were supplied. Gibson denied any intention to defraud and said that he was still waiting for the instruments. He was ordered to refund the money.

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from December 15th:—

Bird (design only). No. 457,156. Class 8. Portable instruments and apparatus for use in radio-telegraphy and telephony.—Cahill & Co., Ltd., 64, Newman Street, W.1.

CCCC—Four Seas (Chinese lettering and design). No. 471,280. Class 8. Rubber-insulated electric cables.—Callender's Cable & Construction Co., Ltd.

Silvertown. No. 472,211. Class 8. Electric cables and conductors, electrical batteries and cells and parts thereof, electrical signalling instruments and apparatus, electrical indicating and recording instruments and apparatus, electrical testing and measuring instruments and apparatus, and apparatus and instruments for use in radio-telegraphy and telephony.—India Rubber, Gutta Percha & Telegraph Works, Ltd.

Crab Tree. No. 474,520. All goods in Class 8. No. 474,532. Class 50. Electric switch covers and plates, electric insulators, electric insulating preparations and materials.—J. A. Crabtree & Co., Ltd.

Published Specifications.

Compiled expressly for this journal by Patent Agents

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1925.

13,544. "Electrically-heated receptacles for heating liquids." Credenda Conduits Co., Ltd., and P. W. Davies. May 25th, 1925. (261,805.)

14,032. "Magnetic slot wedges for dynamo-electric machines." British Thomson-Houston Co., Ltd., F. P. Whitaker, R. I. Martin, and E. E. Robinson. July 27th, 1925. (261,816.)

13,070. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). July 27th, 1925. (261,817.)

19,391. "Sparking plugs for internal-combustion engines." R. L. Aspden. July 30th, 1925. (261,820.)

20,648. "Wireless signalling apparatus." Dayton Fan & Motor Co. August 23rd, 1924. (258,882.)

20,708. "Electric protective systems." Electrical Improvements, Ltd., and L. C. Grant. August 19th, 1925. (261,826.)

21,017. "Mechanism for operating and controlling electric switches, doors, lids and covers of boxes, and other mechanical devices." A. F. Coates. August 21st, 1925. (261,828.)

21,163. "Coils for electrical transformers." British Electric Transformer Co., Ltd., and J. Routhaan. August 24th, 1925. (Addition to 184,207.) (261,836.)

21,445. "Method for automatically controlling electrical apparatus in accordance with the circuit conditions." General Electric Co., Ltd., and A. E. Angold. August 27th, 1925. (261,844.)

21,497. "Means for wireless communication." Secret Wireless, Ltd., and J. D. Chisholm. August 27th, 1925. (261,847.)

21,512. "Electrical heating devices for baking-ovens." Baker Perkins, Ltd., and G. B. Baker. August 27th, 1925. (261,848.)

21,766. "Electrical contacts, particularly for use in automatic telephone apparatus." Standard Telephones & Cables, Ltd. (G. Deakin). August 31st, 1925. (261,857.)

21,786. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and W. Saville. August 31st, 1925. (261,859.)

22,139. "Grid leaks and condensers for use in connection with radio apparatus." R. H. Winter and H. C. Daly. September 4th, 1925. (261,864.)

23,028. "Horns for use in wireless telephone or other sound-reproducing apparatus." Johnson & Phillips, Ltd., and J. R. Penney. September 15th, 1925. (261,871.)

23,329. "Loud-speaking telephones." S. G. Brown. September 18th, 1925. (261,875.)

24,185. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. E. Ostline. September 28th, 1925. (261,880.)

25,134. "Plug-in type inductance coils for use in radio apparatus." J. W. Mander. October 8th, 1925. (261,886.)

25,548. "Electric relays." T. W. Ross and Metropolitan-Vickers Electrical Co., Ltd. October 13th, 1925. (261,890.)

26,035. "Wireless receiving apparatus." S. L. Forbes. October 19th, 1925. (261,893.)

28,566. "Thermionic valve wave-meters and the like." K. E. Edgeworth. November 13th, 1925. (261,905.)

28,766. "Electric fuse and like fittings." W. T. Henley's Telegraph Works Co., Ltd., and W. H. Nichols. November 14th, 1925. (261,906.)

29,990. "Thermionic valves." General Electric Co., Ltd., and F. Smith. November 27th, 1925. (261,915.)

32,340. "Electrical selector device." H. D. De M. Carey. December 22nd, 1925. (261,932.)

1926.

314. "Telegraph cables provided with loading coils." Dr. H. W. G. Salinger. January 23rd, 1925. (246,456.)

5,940. "Vehicle head lights or other searchlights." R. Bosch Akt.-Ges. September 14th, 1925. (258,215.)

7,853. "Sound-amplifying, reducing or recording instruments or devices." A. E. D. B. Rod. March 22nd, 1926. (261,972.)

9,690. "Electric line welding apparatus." British Thomson-Houston Co., Ltd. April 11th, 1925. (250,619.)

10,195. "Electric hair brushes." R. A. Shortland. April 19th, 1926. (261,983.)

11,303. "Electric circuit connectors." British Thomson-Houston Co., Ltd. May 18th, 1925. (252,144.)

11,340. "Electrical water-heating apparatus." O. Graber. April 29th, 1925. (251,647.)

12,946. "Scanning devices for television systems." Metropolitan-Vickers Electrical Co., Ltd. May 25th, 1925. (252,387.)

13,217. "Electric heating devices." British Thomson-Houston Co., Ltd. May 25th, 1925. (252,406.)

13,345. "Electrical system and apparatus for controlling the headlights of motor vehicles and the like." F. K. Moore. May 26th, 1926. (261,999.)

13,853. "Asynchronous dynamo-electric machines." Neufeldt & Kuhnke. June 2nd, 1925. (Addition to 220,632.) (253,113.)

15,646. "Electrical condensers." W. H. Goodman and Dubilier Condenser Co. (1925), Ltd. June 21st, 1926. (262,006.)

16,344. "Electric incandescent lamps and similar devices." British Thomson-Houston Co., Ltd. June 29th, 1925. (254,345.)

16,571. "Asynchronous motors with short-circuited rotor." Ateliers de Constructions Electriques de Charleroi Soc. Anon. August 11th, 1925. (256,936.)

17,314. "Cooling and ventilating systems for dynamo-electric machinery." Metropolitan-Vickers Electrical Co., Ltd. July 23rd, 1925. (255,849.)

17,326. "Electric switches." British Thomson Houston Co., Ltd. July 13th, 1925. (255,116.)

18,352. "Electric batteries." H. T. Harrison and G. Campbell. January 13th, 1926. (Divided application on 1,041'26.) (262,016.)

19,041. "Arc-rupturing devices for electric circuit-interrupters." Metropolitan-Vickers Electrical Co., Ltd. September 8th, 1925. (258,234.)

24,060. "Transformer windings." International General Electric Co., Inc. September 29th, 1925. (259,216.)